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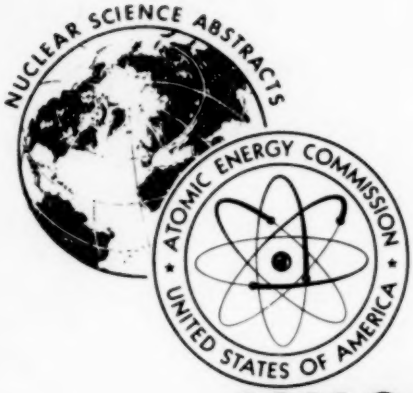

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May 31, 1962

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Volume 16, Number 10 May 31, 1962

NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

11352 (IS-348) ANNUAL SUMMARY RESEARCH REPORT IN ENGINEERING, JULY 1, 1960–JUNE 30, 1961. (Ames Lab., Ames, Iowa). Aug. 1961. Contract W-7405-Eng-82. 44p.

Research and development progress in chemical, nuclear, and ceramic engineering is reported. Topics covered include design of a fused salt-molten metal extractor, low-temperature studies in fused salt-molten metal extraction, pulse column studies, equilibrium distribution studies, a forced convection loop for circulating liquid Pb–Bi mixtures, development of a liquid metal cooled condenser, effect of inhibitors on the corrosion of stainless steel by the Pb–Bi eutectic, turbulent mass transport in liquids, mass transport in gaseous systems, mass transport in liquid systems with packed tubes, momentum transport in packed tubes, two-phase disperser extractor, single crystal growth, preparation of sodium ethylsulfate, slurry program, engineering properties of materials, corrosion rate studies of U–Cr eutectic in Nb, uranium glasses, self-diffusion of Y_2O_3, emissivity of refractory oxides, refractory protective coatings for Y, mechanical properties of MgO and MgO–CaF_2, and oxidation characteristics of $MoSi_2$. (M.C.G.)

11353 (LA-2662) A PUNCHED-CARD MACHINE METHOD FOR MANAGEMENT OF NUCLEAR MATERIALS. E. L. Christensen, J. A. Leary, J. P. Devine, and W. J. Maraman (Los Alamos Scientific Lab., N. Mex.). Jan. 1962. Contract W-7405-eng-36. 41p.

A punched-card machine method is described for use in nuclear material process accounting. Although the specific materials considered are fissile and fertile nuclides, the system can be applied, with slight modification, to any material. (auth)

11354 (NP-11417) INTERNATIONAL TRADE UNION SEMINAR ON NUCLEAR ENERGY PROBLEMS ORGANIZED AT DUSSELDORF, GERMANY, NOVEMBER 29–DECEMBER 2, 1960. Final Report. (Organization for Economic Co-Operation and Development, Paris). 213p.

Eleven papers were presented dealing with general technical aspects of nuclear energy and radioisotopes, economic and social aspects of nuclear power, radiation protection, industrial radioisotope use, and the effects of nuclear power on trade unions. (J.R.D.)

11355 (TID-14725) STATUS—FISCAL YEARS 1960 AND 1961. (California. Univ., Berkeley and Livermore. Lawrence Radiation Lab.). Contract [W-7405-Eng-48]. 190p. (UCRL-Pub-34).

Research progress at Lawrence Radiation Laboratory for the fiscal years 1960 and 1961 is reviewed. The auxiliary groups and financial planning that supported this progress is discussed. A summary of the proposed 10-yr. development plan is presented. (M.C.G.)

11356 (WT-1) PART 1. INSTRUMENTATION FOR STRUCTURES PROGRAM. ANNEX 3.4 OF SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. Paul A. Northrop (Sandia Corp., Albuquerque, N. Mex.). Jan. 1951. Operation GREENHOUSE. 144p.

Instruments are described which were used to measure the blast effects on the structures during Operation Greenhouse. Measurements made on buildings included air pressure, acceleration, displacement, strain, earth pressure, footing pressure, and time-of-break measurements. In addition Stimascope (sound-time-in-materials), tests, Whittemore strain gage tests, surveying measurements, and natural period of vibration measurements, were made before, and repeated after, the blast. The magnitude of the task limited the type of end measurements to the simplest that would give adequate information. Availability, cost, and ease with which gage responses could be remotely recorded on magnetic tape, were also controlling factors in the selection of the instruments used. A list of the equipment, photographs, diagrammatic drawings and wiring circuits, and data from preliminary tests of the equipment are included. (C.H.)

11357 (WT-18) CONTROL STUDIES PERFORMED IN THE UNITED STATES AND AT ENIWETOK. PARTS I, II, IV, AND VI. ANNEX 2.2 OF SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. (Los Alamos Scientific Lab., N. Mex.; Naval Medical Research Inst., Bethesda, Md.; Naval Radiological Defense Lab., San Francisco; and Oak Ridge National Lab., Tenn.). 1951. Operation GREENHOUSE. 171p.

A high degree of correlation was found between the thymic weight loss in mice and the dosage of x radiation over the range of 75 to 900 r. Splenic weight loss proved satisfactory as a biological indicator over the range of 150 to 600 r. The response of mice splenic and thymic net weight to the mixed radiation in a thermal neutron column was found to be qualitatively the same as that seen following exposure to x radiation. The relationship of chromosome breakage frequency to radiation dose in the flowering plant Tradescantia (spiderwort) was determined for three experiments designed to simulate anticipated field conditions for atomic explosions. Studies are reported which were made to provide control x-ray dose-mortality data for comparison with field mortality data obtained from mice exposed to

atomic bomb nuclear radiations. Mean survival times and the pattern of deaths as a function of dose and time are presented and discussed. Lethal dose curves established for 110 to 160 lb swine exposed to 2,000 kvp total-body x radiation at 2 m indicate that bilateral (one-half the total dose to each lateral aspect) irradiation is more lethal than unilateral (total dose to one lateral aspect) irradiation. The dependence of dose distribution on method of x radiation and wave length, the importance of uniform dose distribution, and the difficulties encountered in obtaining uniform dose distribution in a subject 28 cm thick are discussed. From a study of the effects of exposure of swine to tropical conditions for a period of several hours in metal containers similar to those used for exposure during Operation Greenhouse it was concluded that the confinement did not affect significantly the response of the animals to irradiation. Lethal dosage determinations and pathological effects of various doses of bilateral total-body x irradiation on dogs are reported. Data indicate that confinement of dogs for several hours in Al cages under conditions similar to those used at Operation Greenhouse did not affect significantly the response of the animals to irradiation. (C.H.)

11358 (WT-29) U. S. AIR FORCE STRUCTURES. ANNEX 3.3 [OF] SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. Bert E. Pettitt (Air Materiel Command. Air Installations Div., Wright-Patterson AFB, Ohio). Aug. 1951. Operation GREENHOUSE. 416p.

Results are reported in an investigation of the relationship of blast to structural-response damage. Methods for computing blast loading and response from basic blast data were developed and applied to the selected test structures to predict their behavior. Theoretical results are compared with test results to determine the validity of the analytical methods, the model relationships, and the magnitude and regimen of the several parameters. Instruments used in measuring the effects of blasts on the structures are described. Results of the tests indicate that the structures behaved as expected. It was concluded that pretest analytical methods are satisfactory, that there exists a definite scale relation of loading between small-scale models and prototypes, and that the basic parameters can be applied to other structures. (C.H.)

11359 (WT-59) U. S. AIR FORCE STRUCTURES. APPENDIX E. BLAST LOADING AND STRUCTURAL RESPONSE. SECTION 1. GENERAL BLAST LOADING AND RESPONSE. ANNEX 3.3 [of] SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. Bert E. Pettitt (Air Materiel Command. Air Installations Div., Wright-Patterson AFB, Ohio and Illinois Inst. of Tech., Chicago. Armour Research Foundation). Mar. 1951. Operation GREENHOUSE. 102p.

The loading problem is to predict the forces imposed on an isolated structure which is struck by a given blast wave moving across the structure in a direction normal to one of its faces, and the net horizontal and vertical forces as function of time are found for the period during which the structure is immersed in the wave. The development of the loading method was accomplished by a study of known theory and existing experimental data. Data obtained by shock tube studies were combined with theory to produce a set of fundamental parameter plots and a rational load-computation method. Equations of motion, used in the prediction of response, are discussed and possible alternate methods of solutions are given. (C.H.)

11360 (WT-60(Ref.)(Pt.IV)) U. S. ARMY STRUCTURES. APPENDIX 2. AS-BUILT CONSTRUCTION. ANNEX 3.1 OF SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. (Ammann and Whitney, New York). Nov. 1951. Operation GREENHOUSE. 115p.

Drawings of U. S. Army structures and components are presented. These structures were tested during Greenhouse Operation for the effects of blast. (C.H.)

11361 (WT-71) ATMOSPHERIC CONDUCTIVITY. ANNEX 4.6 OF SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. Samuel C. Coroniti, G. R. Wait, and A. J. Parziale (Air Force Cambridge Research Center, Mass.). Sept. 1951. Operation GREENHOUSE. 90p.

Aerial surveys were made during Greenhouse Operation to obtain information on the disposition of radioactive matter in an atomic cloud, on the physical and electrical characteristics of particles composing the cloud, an overall movement of an atomic cloud, on the efficiency of mechanical filters for the collection of radioactive material composing an atomic cloud, the magnitude of fall-out and its relation to the direction and velocity of the wind, and on the radioactive decay of fall-out material on adjacent islands. Data are presented and results are discussed. (C.H.)

11362 (WT-75(REF)) U. S. ARMY STRUCTURES. APPENDIX 3. MATERIALS TESTS. ANNEX 3.1 [OF] SCIENTIFIC DIRECTOR'S REPORT OF ATOMIC WEAPON TESTS AT ENIWETOK, 1951. (Ammann and Whitney, New York). Aug. 1951. Operation GREENHOUSE. 82p.

The testing program was designed to supply information on the strength of the precast and poured-in-place concrete, the reinforcing steel, and the structural steel. Most of the materials were subjected to a number of independent tests and the values used in the post-test analysis were based on the results thereof. Data from these tests are presented in the report. (C.H.)

11363 (WT-767) MEASUREMENT OF THERMAL RADIATION WITH A VACUUM MICROPHONE. J. Lloyd Bohn, Ralph J. Cowie, Jr., and Marcus D. O'Day (Air Force Cambridge Research Center. Geophysics Research Directorate, Mass.). Mar. 1954. Project 8.2 of Operation UPSHOT-KNOTHOLE. 52p.

The object of this project was to obtain a quantitative proof of the feasibility of the vacuum microphone for the measurement of the intensity of thermal radiation from nuclear detonations. Measurements were made on ten bursts. Sufficient engineering data were obtained to demonstrate that the vacuum microphone is a suitable device for the measurement of intense thermal radiation with good time resolution. Microphones were developed with high sensitivity and low noise factors. (auth)

11364 (WT-773) PHYSICAL CHARACTERISTICS OF THERMAL RADIATION FROM AN ATOMIC BOMB DETONATION. Andrew Guthrie and R. W. Hillendahl (Naval Radiological Defense Lab., San Francisco). Feb. 1954. Project 8.10 of Operation UPSHOT-KNOTHOLE. 77p.

Measurements of some physical characteristics of thermal radiation were made at varying distances on Bursts 3, 4, 9, 10, and 11 at Upshot-Knothole. In addition to measurements of the total thermal energy received as a function of distance, measurements were made of the thermal pulse shape, the spectral distribution, the energy reflected from the ground, and the energy scattered by the atmosphere. The results from this operation were consistent with those obtained at Buster and Tumble-Snapper. The thermal yields obtained for Bursts 4, 9, 10, and 11 were based on transmission coefficients of 95, 92, 91, and 95 per cent, respec-

tively. The data obtained in this operation appear to fit, within experimental error, scaling relationships derived on the basis of previous operations. For example, the time to second peak, tp in seconds, fits the relationship $W = 850\ tp^2$, where W is the total yields of the weapon in KT of TNT equivalent. The measurements made from the B-50 aircraft again indicate the importance of ground-reflected energy. (C.H.)

11365 (WT-777) SUPPLEMENTARY PRESSURE MEASUREMENTS. Vernon E. Benjamin (David Taylor Model Basin, Carderock, Md.). May 1955. Project 8.12b of Operation UPSHOT-KNOTHOLE. 48p.

Preshock pressures are defined as any change in the pressure datum between weapon detonation time and main shock or precursor arrival time. An investigation was made of the possibility that preshock pressures might be generated by sudden exposure of a surface to intense thermal irradiation, as from an air burst of an atomic weapon. Results are reported from measurements of pressure changes recorded at the center of test panels and also at ground level control stations located 1500 ft. and 3000 ft. from ground zero for atomic explosions. Observations are reported. No positive conclusions were reached. (C.H.)

11366 (WT-779) TECHNICAL PHOTOGRAPHY. William R. Greer, Jr. and Ernest F. Dukes, Jr. (Armed Forces Special Weapons Project, Washington, D. C.). Jan. 1954. Project 9.1 of Operation UPSHOT-KNOTHOLE. 135p.

A centralized organization was responsible for all technical motion-picture and still photography required by the various military effects projects at Operation Upshot-Knothole. Motion-picture photography was employed to record the shock front of the blast and the effects of blast and thermal radiation on various test objects. All zero time technical photography was done from individual photo stations which were located at distances between 1150 ft and 1500 ft from ground zero. Results of the photography were successful at distances exceeding 2500 ft from ground zero. At closer distances, dust, thermal and nuclear radiations, blast, and rapidly changing illumination greatly interfered with obtaining satisfactory results. In general, it was concluded that photographic instrumentation is feasible within certain limitations. (C.H.)

11367 (JPRS-11873) NEUTRONS FROM AN ATOMIC EXPLOSION. P. A. Yampol'skii (Yampol'skiy). Tranlation of p.1-132 from "Neitrony Atomnogo Vzryva" (a publication of the State Publishing House for Atomic and Technological Literature, Moscow, 1961). 165p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 8452.

11368 (UCRL-Trans-768(L)) NUCLEAR ENERGY IN EXPLOSIVE MINING WORKS. K. K. Ponomarev. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Przegląd Górniczy, 17: 209-14(1961). 16p.

The potential of nuclear energy for surface mining is examined. Included is a discussion of shelter structures for personnel protection and examples for estimating forces acting on the structures. (J.R.D.)

11369 EXPERIMENTATION ON AN INDUSTRIAL SCALE, NECESSARY PREMISE FOR THE FUTURE ECONOMIC USE OF NUCLEAR ENERGY. Vittorio De Biasi. Econ. intern. fonti energia, 5: 379-96(May-June 1961). (In Italian)

The characteristics of the present energy needs of Italy are discussed. The predictable costs for nuclear energy production—such as relative capital costs, fuel costs, costs for personnel, operation, and maintenance—are determined. The possible contribution of nuclear energy to the total energy consumption in the next few years is indicated. In conclusion, the necessity for experiments on an industrial scale is emphasized. (J.S.R.)

11370 THE CONTRIBUTION OF ELECTRONUCLEAR ENERGY TO THE FULFILLMENT OF ELECTRICAL POWER NEEDS: CONDITIONS AND TIMES OF SUCH CONTRIBUTION. Noverino Faletti. Econ. intern. fonti energia, 5: 397-416(May-June 1961). (In Italian)

Problems concerning the introduction of nuclear power into the Italian power complex are reviewed. The characteristics of the Italian power system are first discussed. Then predictions are made on the electrical needs of Italy. The availability of energy of conventional origin—hydraulic and thermoelectric sources—is determined, and the design of electronuclear plants is indicated. The future ratio between hydraulic, thermal, and nuclear production of electrical energy in Italy is discussed. (J.S.R.)

11371 THE PUBLIC CONTROL OF THE PRODUCTION OF ELECTRONUCLEAR ENERGY, SIGNIFICANCE AND LIMITS. Piero Savini. Econ. intern. fonti energia, 5: 491-513(May-June 1961). (In Italian)

The normative principles which control the production of electric energy in Italy and their practical results are defined. The orientation of these principles in terms of "classical" and nuclear power plants is then discussed. The English nuclear program is considered. Transitory and permanent components of the characteristics of the production of electronuclear energy are reviewed. The evolution of controls in various countries and some recent legislation is reviewed. In conclusion, the orientation of the control in Italy is discussed. (J.S.R.)

11372 IZUCHENIE ZHIVOTNOGO ORGANIZMA, RYBNOE KHOZYAISTVO, PISHCHEVAYA PROMYSHLENNOST. TRUDY VSESOYUZNOI NAUCHNO-TEKHNICHESKOI KONFERENTSII PO PRIMENENIYU RADIOAKTIVNYKH I STABIL'NYKH ISOTOPOV I IZLUCHENII V NARODNOM KHOZYAISTVE I NAUKE, 4-12 APRELYA 1957. (Studies of Animal Organism, Fish, and Food Industry. Transactions of the All-Union Scientific-Technical Conference on Application of Radioactive and Stable Isotopes and Radiation in National Economy and Science, Moscow, April 4-12, 1957. B. N. Stepanov, ed. Moscow, Publishing House of the Academy of Sciences, 1958. 264p.

Thirty papers are presented on the scientific and industrial applications of isotopes and radiation in agriculture, animal husbandry, and the fish and food industry. (R.V.J.)

BIOLOGY AND MEDICINE

General and Miscellaneous

11373 (AD-259234) ANNUAL PROGRESS REPORTS ON RESEARCH FOR ARMY MEDICAL RESEARCH AND DEVELOPMENT CONTRACTS, JULY 1, 1960–JUNE 30, 1961. (Armed Forces Inst. of Pathology, Washington, D. C.). 95p.

Eight papers are included which treat topics such as effects of radiosterilized food, antibody labeling, effects of microwaves, submicroscopic particles, respiratory diseases, and detection of pathogens. Separate abstracts were prepared for all eight papers. (D.L.C.)

11374 (AD-259234(p.3-8)) NUTRITION: RADIATION AND STERILIZATION OF FOOD. F. D. Maurer and Martin A. Ross (Armed Forces Inst. of Pathology, Washington, D. C.).

A research program on the possible toxic effects of radiosterilized foods is described. Irradiated foods were fed to rats, dogs, and monkeys for a period of two years, and histological sections of tissues were taken for examination. Data were received for 2662 rats, 215 dogs, and 19 monkeys, about 85% of the total. Preliminary inspection of the data for dogs indicate no evidence that consumption of irradiated foods produces histopathologic changes. (D.L.C.)

11375 (AD-259234(p.9-17)) STUDIES ON IMMUNIZATION. LABELED ANTIBODY TECHNIQUE FOR ELECTRON MICROSCOPY. Felix Borek, Richard E. Hartman, and Roberta S. Hartman (Armed Forces Inst. of Pathology, Washington, D. C.).

The development of coupling techniques for labeling antibodies with the electron-opaque protein ferritin is described. Separation of the resulting conjugates from uncoupled ferritin and globulin is discussed. The problems involved in the application of conjugates to identification of antigens in electron microscopy are described. (D.L.C.)

11376 (AD-259234(p.18-30)) INTERNAL MEDICINE. A STUDY OF MOTOR END PLATES IN ANIMALS AND MAN. Joe M. Blumberg, Walter C. Bauer, and Sumner I. Zacks (Armed Forces Inst. of Pathology, Washington, D. C.).

A study of the fine structure of motor end plates from five patients with myasthenia gravis showed definite anatomical abnormalities in both the neural and muscular components of the synapse. These changes, characterized by distorted and deranged secondary synaptic clefts, focal absence of muscle cell surface membrane, decreased numbers of sole plate mitochondria, and loss of fine structure detail in the terminal axon branch, are interpreted as degenerative changes in the motor end plate and have not been seen in normal human synapses. The number of affected end plates and the severity of the degenerative changes roughly parallels the clinical state of the disease in these five cases. Studies with ferritin-labeled Staphaureus antibodies demonstrated satisfactory electron microscopic localization of the antibody within a capsule-like material of the organism. In a similar manner, ferritin-labeled Botulinus neurotoxin B was found localized to the "basement membrane" material in the primary and secondary synaptic clefts of mouse motor end plates. Observations on the fine structure changes in the motor end plates and skeletal muscle of mice following denervation were made for periods up to 24 weeks post-denervation. Degeneration and retraction of the terminal axon branch is complete within one week; however, the sole plate sarcoplasm and secondary synaptic folds remain intact for at least five weeks. Examination of the muscle cell shows a regular spectrum of fine structure changes during the post-denervation period. (auth)

11377 (AD-259234(p.31-46)) RADIATION AND THERMAL BURNS. BIOLOGICAL AND BIOCHEMICAL EFFECTS OF MICROWAVES. R. E. Stowell, Bryce L. Munger, Edward S. Reynolds, Jr., and Vaman S. Waravdekar (Armed Forces Inst. of Pathology, Washington, D. C.).

Microwave equipment and irradiation cells for the microwave irradiation of biological and biochemical systems are described. The problem of birefringence in microwave fields is discussed. Solutions of yeast alcohol dehydrogenase were irradiated at 1 to 40 Mc and activity decreases were noted. (D.L.C.)

11378 (AD-259234(p.47-56)) PROCEDURES FOR QUANTITATIVE ELECTRON MICROSCOPY. PHOTOMETRIC PROCEDURE FOR WEIGHT DETERMINATION OF SUBMICROSCOPIC PARTICLES. G. F. Bahr and E. H. Zeitler (Armed Forces Inst. of Pathology, Washington, D. C.).

A photometric method was developed for the rapid determination of the weight of isolated submicroscopic particles down to 10^{-18} g. The method can be applied to population studies of heterogeneous biological particles. (D.L.C.)

11379 (AD-259234(p.57-68)) INTERNAL MEDICINE. INVESTIGATION OF RESPIRATORY DISEASES OF LABORATORY ANIMALS. Fred D. Maurer, Robert A. Crandell, James R. Ganaway, P. H. Craig, J. L. Adcock, W. H. Nieman, and D. F. Hersey (Armed Forces Inst. of Pathology, Washington, D. C.).

A description is given of a research program on the nature, prevention, and control of some of the major respiratory diseases of laboratory animals, particularly cats and rats. Results of studies on feline viruses are summarized. Rats were raised free from chronic murine pneumonia, and a virus-like agent which causes this disease was isolated from rat colonies all over the U. S. and preliminary characterization results given. Observations are given on snuffles in rabbits. (D.L.C.)

11380 (AD-259234(p.69-87)) COMMUNICABLE DISEASES. PREPARATION AND USE OF SPECIFIC FLUORESCENT ANTIBODIES. Joseph F. Metzger, Joe M. Blumberg, Chauncey W. Smith, Walter F. Malizia, M. David Hoggan, and Alice Kase (Armed Forces Inst. of Pathology, Washington, D. C.).

Investigations were made by immunofluorescent and immune electron microscopy techniques in the detection and pathogenesis of disease processes. Preliminary results indicate a minimum of 10^4 logs of virus of equine abortion virus for its specific identification by immunofluorescence. The virus was detected by immune electron microscopy in the nuclei of infected hamster livers. Immunofluorescent techniques are discussed. Thai 16 virus, associated with hemorrhagic fever, can be detected as well as several mycotic agents that have been implicated with infectious disease processes. Model systems were used to study the involvement of the animal host with a virus that produces a fatal hepatitis in hamsters. Viral inclusion bodies were studied by conventional staining, immunofluorescent, and immune electron microscopy techniques. The results are discussed. (auth)

11381 (AD-259234(p.88-94)) TRAUMATIC SURGERY AND SHOCK. STRUCTURE AND FUNCTION OF OCULAR TISSUE. Benjamin Rones, Lorenz E. Zimmerman, and Ben. S. Fine (Armed Forces Inst. of Pathology, Washington, D. C.).

A description is given of the research program on the ultrastructure of ocular tissues and its correlation with functions and lesions of military importance. Results of electron microscopic studies are summarized. (D.L.C.)

11382 (IS-371) A SYSTEM FOR ADMINISTERING AIR-BORNE CONTAMINANTS BY INHALATION. Robert Monroe Cook and R. W. Fisher (Ames Lab., Ames, Iowa). May 1961. Contract W-7405-eng-82. 114p.

A facility for subjecting animals to aerosols is designed, consisting of one large inhalation unit and five smaller inhalation units. The large inhalation unit is capable of handling animal cages containing twenty rabbits and forty mice. Each of the smaller inhalation units is capable of handling a 25-kg dog. The smaller inhalation units are designed to produce a uniform contaminant distribution within the unit. A study is made to define the nature of the contaminant distribution. The system features "absolute" filtration of throughput air and precise control of certain parameters, e.g., throughput air flow, temperature, and relative humidity. (auth)

11383 (NP-11409) USE OF URANIUM TO CONTROL MARINE-BORER DAMAGE. Progress Report No. 2 Covering Period August to October 1961. J. Schlabitz and C. C. Walden (British Columbia Research Council, Vancouver). Nov. 22, 1961. For Canada Uranium Research Foundation, Toronto. 25p. (CURF-R-22)

Status is reported for a research program on the possible use of a toxic organic uranium compound to increase the toxicity of creosote to marine borers (Limnoria tripunctata) and thus improve its performance as a preservative for marine piling. Methods are given for the preparation of some organic uranium compounds. Preliminary impregnation and leaching tests were made on wood panels with creosote containing uranium chelates of 8-quinolinol derivatives. (D.L.C.)

11384 (NP-11424) DEVELOPMENT OF RATION TYPE PORK ITEMS. Report No. 6 (Final), January 15, 1960–July 15, 1961. V. J. Kubala (Armour and Co., Chicago). Contract DA-19-129-QM-1541. 13p.

Because of the need to develop a satisfactory irradiated pork item, numerous tests were conducted to determine whether selected additives by injecto-pumping loins would improve their texture and flavor. Boneless pork loins were injecto-pumped with 40° brine solution, to which various compounds and solutions were added. The compounds used in these tests consisted of tripolyphosphate, mixed phosphates, sodium nitrite, isoascorbic acid, pork loin emulsion, combination of niacin, isoascorbate, and dextrose, and thiamine. Solutions used were barbecue sauce and 10% vegetable extract. The loins were also injecto-pumped with a barbecue sauce-brine mixture and the surface of the loins rubbed with a spice mixture containing sugar, onion powder, mono-sodium glutamate, garlic powder, white pepper, and marjoram. The best results and a product which had acceptable characteristics were obtained when a mixture of barbecue sauce and 40° base brine solution was injecto-pumped into the pork loins. The loins were processed by cooking, chilling, slicing, and packing with barbecue sauce prior to irradiation. (auth)

11385 (NP-11449) LONG-TERM RAT FEEDING STUDIES: IRRADIATED ORANGES. Final Report. A. W. Phillips, H. R. Newcomb, and D. Shanklin (Syracuse Univ., N. Y. Biological Research Labs.). June 26, 1961. Contract DA-49-007-MD-791. 47p.

Toxicological evaluations of irradiated oranges were conducted on 4 generations of rats during a 2-year feeding program. Data are presented on growth, breeding performance, life span, hematological values, enzyme activity, and histopathological changes in animals fed a diet containing oranges irradiated with electron beams up to 0.279 megarad. No significant biological effects were noted. (C.H.)

11386 (NP-11560) LONG-TERM DOG AND RAT FEEDING EXPERIMENT EMPLOYING IRRADIATED BEEF STEW (C-RATION). Final Report, March 1, 1957 to August 1, 1961. William B. Deichmann (Miami Univ., Coral Gables, Fla. School of Medicine). Contract DA 49-007-MD-785. 33p.

Beef stew irradiated at a level of 5.58 megarad and 2.79 megarad was fed to dogs as 35% of the diet for a period of two years. Non-irradiated beef stew of similar origin was fed to control animals. A breeding experiment was carried out simultaneously, and hematological studies and urine analyses were conducted on all animals. After two years feeding, all dogs were sacrificed and complete histopathological studies performed on the tissues. No indications were found of any toxic effects due to the feeding of irradiated beef stew. (C.H.)

11387 (ORO-517) SEMI-ANNUAL PROGRESS REPORT [ON AGRICULTURAL RESEARCH], JANUARY 1–JUNE 30, 1961. (Tennessee. Univ., Oak Ridge. UT-AEC Agricultural Research Lab.). Contract AT-40-1-GEN-242. 101p.

Progress in agricultural research is reported. The metabolism of fission products and chemically related nuclides by beef cattle, dairy cattle, sheep, swine, and poultry was studied. The effects of external radiation were investigated by clinical and physiological studies in animals, pathology, physiology of reproduction, and plant genetics studies. Radiochemical studies were carried out. (M.C.G.)

11388 (TID-14994) THE ECOLOGY OF "ACANTHARIA" IN RELATION OF THE CIRCULATION OF Sr IN THE SEA. Progress Report (Scientific Background and Results Obtained up to September 30, 1961). Bruno Schreiber (Parma, Italy. Università. Istituto di Zoologia e Anatomia Comparata). Contract AT(30-1)-2607. 5p.

Status is reported for the research program to determine if Acantharia, a plankton having a $SrSO_4$ skeleton, plays a part in the capture and distribution of Sr natural and radioactive isotopes in the food chain. A positive correlation was found between the Sr content in plankton and the relative amounts of Acantharia in the plankton. Work was started on the determination of radiostrontium and on the reproductive activity of Acantharia. (D.L.C.)

11389 (TID-15141) SOME PHYSICAL CHEMICAL PROPERTIES OF RIBONUCLEOPROTEIN FROM RAT LIVER MICROSOMES. Mary G. Hamilton, Liebe F. Cavalieri, and Mary L. Petermann (Cornell Univ., Ithaca, N. Y. Medical Coll.). [1961]. Contract [AT(30-1)-910]. 20p.

Rat liver microsomal ribonucleoprotein particles, or ribosomes, were isolated by differential centrifugation after release from the microsomal membranes by 0.5% sodium deoxycholate and purified by a final precipitation with 0.005 M barium acetate or 0.01 M magnesium chloride. The ribonucleoprotein had an anhydrous density of 1.51 g/ml; the density of zero sedimentation in sucrose solutions was 1.41 g/ml. The chief difficulties in measuring other physical chemical properties arose in obtaining the 80S component free of other components, especially the

larger polydisperse aggregates. The intrinsic viscosity was 0.11 dl/g. Zone centrifugation into a sucrose gradient was used to fractionate solutions of RNP for characterization by light scattering. The molecular weight of the 80S component was found to be 3.6 million with an estimated uncertainty of about 10%. (auth)

11390 (TID-15142) THE PURIFICATION AND PROPERTIES OF RIBOSOMES FROM THE THYMUS NUCLEUS. A. O. Pogo, B. G. T. Pogo, V. C. Littau, V. G. Allfrey, and A. E. Mirsky (Rockefeller Inst. for Medical Research, New York), and M. G. Hamilton (Sloan-Kettering Inst. for Cancer Research, New York). [nd.]. Contract [AT(30-1)-910]. 34p.

Methods are described for the isolation and purification of ribonucleoprotein particles (ribosomes) from isolated calf thymus nuclei. About half of the total ribonucleic acid of the nucleus can be recovered in the purified ribosome fraction. Nuclear ribosomes can be purified by centrifugation in a sucrose density-gradient. The ribosome peak contains about 36% RNA. Treatment of the peak material with deoxycholate removes much of the protein. The resulting ribosomes have a sedimentation coefficient of 78 S and about 60% of their mass is RNA. The average base composition of this ribosomal RNA is given and compared with that of other nuclear RNA fractions. The changes in state of the nuclear 78 S ribosome with changing pH, ionic strength, and Mg^{2+} ion concentration are described. Electron microscopy of isolated ribosomes after shadow-casting with chromium indicates that the 78 S ribosomes are about 200 Å in width. (auth)

11391 (UCLA-502) HIPPURAN I^{131} RENOCYSTOGRAM. NEW TECHNIQUES, INTERPRETATIONS AND EXPERIENCES. G. V. Taplin, E. D. Dore, and D. E. Johnson (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Feb. 1962. Contract AT(04-1)-GEN-12. 29p.

The limitations of renocystograms are described along with those of standard clearance methods for evaluating individual renal functions. Original interpretations of radiorenograms are modified and the physiological basis of normal renocystogram dynamics is clarified. The heights of the renal vascular segments are no longer considered useful indices of renal vascular capacity. Analysis of the effects of fluid restriction and loading doses of para-aminohippurate (PAH) on renocystogram dynamics has led to new concepts and terminology for the tubular segments. These segments are now called tubular transport segments to imply a close relation between blood supply and tubular cell function and a time factor for movement of tracer from the blood into the cells and secretion into the collecting tubules. A new concept of minimum tubular transport time is developed and its relation to urine flow is described. Fluid restriction sufficient to reduce urine formation to 1 ml/minute/kidney may increase tubular transport time from the normal of about 2.5 minutes to 5 or 6 minutes. A difference in tubular transport time between kidneys of 1 minute or more suggests inequality of urine flow. Recent clinical experiences with renocystograms in chronic pyelonephritis and occlusive renal artery disease demonstrate the diagnostic value of current concepts of renocystogram interpretations. (auth)

11392 (UCRL-Trans-779) STUDY OF THE ASSOCIATION: POLYCYTHEMIA-CANCER. Jean Bernard, M. Tubiana, M. Boiron, and R. Pérez. Translated by Raphaella Kingsbury and Thomas Knatt (Univ. of California Lawrence Radiation Lab., Berkeley) from Nouvelle rev. fraç. hématol., 1: 473-8(1961). 16p.

Results are reported from a statistical study of 227 cases of polycythemia treated with radioactive phosphorus. The patients were followed over an average period of $6\frac{1}{2}$ years. Seventeen cases of associated cancer were noted, or 7.4% of the cases. Of 38 deaths observed in the series, 5 were due to some form of cancer, that is, 13% of the cases. The statistical study shows that, in this series, the polycythemia did not involve a significant increase of cancer risk in general. On the other hand, the analysis of the types of cancer reveals an altogether abnormal and significant increase in cancer of the kidney among these subjects. The frequency of cancer of the thyroid is suspected perhaps but not affirmed. There does not exist a particular relationship among the other types of cancer. (auth)

11393 RADIOMERCURY (Hg^{203}) LABELED NEOHYDRIN: A NEW AGENT FOR BRAIN TUMOR LOCALIZATION. Monte Blau and Merrill A. Bender (Roswell Park Memorial Inst., Buffalo). J. Nuclear Med., 3: 83-93 (Mar. 1962).

Hg^{203} Neohydrin has been developed as a replacement for I^{131} albumin in brain tumor scanning. The rapid clearance of non-localized Neohydrin from the blood and the effectiveness of collimation and shielding on the monoenergetic 0.28 Mev gamma rays from Hg^{203} result in improved visualization of tumors with this agent. This improvement is significant, but not dramatic. (auth)

11394 DISPOSABLE EQUIPMENT FOR USE IN ADMINISTERING THERAPEUTIC QUANTITIES OF RADIOACTIVE ISOTOPES. Philip R. Frederick (Latter-Day Saints Hospital, Salt Lake City). J. Nuclear Med., 3: 153-6(Mar. 1962).

Commercially available, disposable equipment can be easily adapted to the administration of therapeutic doses of radioactive isotopes. The flush method of delivery is efficient as well as convenient. (auth)

11395 FIZIOLOGIYA RASTENII, AGROKHIMIYA, POCHVOVEDENIE. TRUDY VSESOYUZNOI NAUCHNO-TEKHNICHESKOI KONFERENTSII PO PRIMENENIYU RADIOAKTIVNYKH I STABIL'NYKH IZOTOPOV I IZLUCHENII V NARODNOM KHOZYAISTVE I NAUKE, 4-12 APRELYA 1957. (Plant Physiology, Argo-Chemistry and Soil Studies. Transactions of the All-Union Scientific Technical Conference on Application of Radioactive and Stable Isotopes and Radiation in National Economy and Science, April 4-12, 1957). V. M. Klechkovskii, ed. Moscow, Publishing House of the Academy of Sciences, 1958. 436p.

Fifty-five articles are included on applications of radioactive and stable isotopes in studies of plant physiology, agricultural chemistry, radiation effects, and on oxidation-reduction processes in growing organisms. (R.V.J.)

Biochemistry, Nutrition, and Toxicology

Refer also to abstracts 11438, 11439, 11443, 11449, 11451, 11452, 11454, and 11457

11396 (AEET/HP/SM-3) TOXICITY AND HANDLING HAZARDS OF NATURAL URANIUM. P. R. Kamath and S. Somasundaram (India. Atomic Energy Establishment, Trombay). July 15, 1958. 30p.

A brief summary is presented concerning results of toxicological studies on the nature of U hazards and on the toxicity of soluble and insoluble U compounds with regard to ingestion, inhalation, injection, and absorption. Most experimental data were obtained on animals, however data on a few human exposures are included. (J.R.D.)

11397 (AEET/HP/SM-8) TOXICITY AND INDUSTRIAL HAZARDS OF TRICHLOROETHYLENE. T. N. Viswanathan Pillai (India. Atomic Energy Establishment, Trombay). Nov. 10, 1960. 20p.

A description is given of the properties and toxic and physiological effects of trichloroethylene. Recommendations are included for its safe industrial use. (J.R.D.)

11398 (AEET/HP/SM-9) TOXICITY AND INDUSTRIAL HAZARDS OF FLUORINE. T. N. V. Pillai and P. R. Kamath (India. Atomic Energy Establishment, Trombay). Nov. 5, 1960. 31p.

An account is given of the toxicity and handling hazards of F and its compounds with particular emphasis on physiological effects and handling safety. Analytical methods for determination of F are included. (J.R.D.)

11399 (TID-15044) ACCUMULATION OF Cs AND K AND GROWTH OF BEAN PLANT IN NUTRIENT SOLUTION AND SOILS. H. Nishita, D. Dixon, and K. H. Larson (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). [Feb. 1962]. Contract AT(04-1)-Gen-12. 31p.

Bean plants were grown to maturity in nutrient solutions and soils to study the influence of Cs and K on the growth and uptake of K, Cs^{137}, and stable Cs. The application of K to Cs^{137}-treated soils relatively high in exchangeable K had only slight effect on the plant uptake of Cs^{137}. Increasing additions of K to Cs^{137}-treated nutrient solution decreased the uptake of Cs^{137}. In both soils and nutrient solutions, the application of K increased the K uptake by plants. Small applications of stable Cs to contaminated soils and nutrient solutions caused a greatly increased Cs^{137} uptake by plants, presumably a carrier effect. Large applications of Cs reduced the uptake of Cs^{137} because of isotopic dilution. Up to a certain threshold level, the plant uptake of K increased with that of stable Cs and appeared to be partly non-competitive with Cs. Bean plants discriminated against Cs. The discrimination between Cs and K varied with K and Cs concentration in the nutrient media. Cesium was toxic to bean plants. This toxic effect was alleviated to some extent by increasing the application of K. In the soils studied, reduction in plant yields occurred when the application of Cs was greater than 8% of the soil cation exchange capacity. (auth)

11400 (TID-15045) ZINC IN BONE. George V. Alexander and R. E. Nusbaum (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). [Dec. 12, 1961]. Contract AT(04-1)-GEN-12. 7p.

In view of a recent report suggesting an increase in zinc level with age, several groups of bone ash samples were re-examined for zinc concentration. No such increase was observed for rats or humans. Zinc in bone seems to be related to the diet in a manner similar to strontium. The retention factor for rats would be 0.40 for zinc as compared to 0.28 for strontium. (auth)

11401 (TID-15155) PROGRESS REPORT [ON MONITORING OF THYROIDAL I^{131} CONCENTRATION]. (Michigan. Univ., Ann Arbor). Feb. 22, 1962. Contract AT (11-1)-70. 15p.

Data are presented graphically on levels of I^{131} in the thyroid glands from adult and fetal humans and hogs from 1958 to 1962. Measurements were also made of levels of I^{131} in adult and fetal human and hog neck muscle, commercial cow's milk, and human breast milk. The influence of the Idaho Falls reactor accident, the two French Sahara Desert atom bomb detonations, and each of the Russian detonations on levels of I^{131} in thyroid glands is discussed. (C.H.)

11402 HYPERTENSION INDUCED IN RATS BY SMALL DOSES OF CADMIUM. Henry A. Schroeder and William H. Vinton, Jr. (Dartmouth Medical School, Hanover, N. H. and Brattleboro Retreat, Vt.). Am. J. Physiol., 202: 515-18 (Mar. 1962).

Female rats on a cadmium-free diet exhibited fluctuating systolic hypertension when given cadmium in drinking water at subtoxic levels (5 ppm) from the time of weaning for 180–240 days. Relatively small accumulations of cadmium in kidney and liver were present, and hypertension was the only sign of toxicity. Male rats failed to show more than a tendency to hypertension when treated similarly. When rats were given choices of sodium chloride in drinking water, females took more water and two to three times as much salt as did males. Animals exposed to sodium chloride drank more water than did those not exposed, whether given cadmium or not. The presence of cadmium and/or hypertension at these concentrations did not affect the intake of salt or water. (auth)

11403 THE MOBILIZATION OF INCORPORATED RADIOSTRONTIUM IN RATS DURING LACTATION. H. Kriegel and G. K. Neumann (Heiligenberg-Instituts, Heiligenberg/Baden, Ger. and Justus-Liebig-Universität, Giessen, Ger.). Atompraxis, 8: 59-60(Feb. 1962). (In German)

The Sr^{90} content in the femur of lactating rats was 55% below that of control animals. The decrease is explained by the decomposition of mineral substance in the skeleton during lactation. (auth)

11404 MANUFACTURE OF C^{14} PROTEIN LAYERS FOR MEASURING RADIOACTIVITY AND DETERMINING THE SELF-ABSORPTION CURVE FOR C^{14} PROTEINS. W. Dirscherl and J. Strehlow (Universität, Bonn). Atompraxis, 8: 60-3(Feb. 1962). (In German)

Discussion is given on working regulations for making even, fissure-free C^{14} protein layers for measurement of radioactivity, self-absorption curves for two C^{14} protein preparations with various specific activity, and a correction curve obtained from them for self-absorption losses. Actual experiences in regard to methodological details are also discussed. (auth)

11405 THE ACTIVITY OF DESOXYRIBONUCLEASE ACID IN NATIVE AND PURIFIED CONDITION. M. Goutier-Pirotte (Université, Liège). Enzymologia, 22: 37-46(1960). (In French)

Acid DNase activity in fresh normal spleen homogenates displays an optimum at pH = 5.15. In spleen homogenates from total-body irradiated rats or in homogenates to which acid, detergent or SH compounds were added, a new form of enzyme activity appears, with an optimum at pH = 4.85. The same shift in the optimum pH is obtained by purification of the enzyme. Denaturation displaces the optimum pH to still more acid values. It is postulated that native DNase, with the optimum pH = 5.15, is a complex between the enzyme and an intracellular factor. A simple purification procedure is described, whereby a 400-fold purified acid DNace is obtained in neutral conditions and with minimized denaturation. (auth)

11406 THE DISTRIBUTION OF INTRAVENOUSLY ADMINISTERED TRACER DOSES OF Bi-206 COMPOUNDS IN THE HUMAN BODY. J. M. Coenegracht and M. Dorleyn (Ziekenhuis Sint Annadal, Maastricht, Netherlands). J. belge radiol., 44: 485-504(1961). (In English)

The behavior of some Bi-206 compounds in the human

body was investigated. The compounds used were seen to have their particular distribution pattern probably determined by their particle size. The Bi compounds used are not suitable for the measurement of the hepatic blood flow. In four patients suffering from malignant disease, practically no radioactivity was found in the cancerous tissue. (auth)

11407 NEW IRRADIATION TECHNIQUE FOR PELVIC TUMORS BY PERINEAL METHOD. P. Marques, A. Bru, J. Faillières, P. Perret, and L. Commanay (Centre Regional Anticancéreux et du Service de Physique Biologique, Toulouse, France). J. belge radiol., 44: 519-35(1961). (In French)

Perineal irradiation by pendular rotational therapy with speed variation opens new ways for the treatment of pelvic tumors. However, it offers some technical, sometimes unsurmountable, difficulties with the rotational beam 55 cm we used. There is an argument in favor of the choice of a 70 cm beam in rotational Co therapy. Moreover, if it is possible to spare the perineal skin and the vulvar mucous membrane, this method determines high parasite doses to the scrotum and testicles in man. In these cases it may be combined with a conventional irradiation method. Control dosimetry shows that it represents a non-neglectable complementary irradiation securing a better local dose distribution in the pelvis. (auth)

11408 THE EFFECT OF FLUORINE ON Sr^{90} ACCUMULATION IN THE SKELETON OF RATS. V. A. Knizhnikov. Med. Radiol., 6: No. 11, 58-62(Nov. 1961). (In Russian)

Rats receiving drinking water with 5 and 15 mg/l of fluorine and control rats receiving water without fluorine were subject to single oral administrations of Sr^{90} in one series of experiments and to chronic administration in another series. It was found that fluorine reduces the concentration of Sr^{90} in the skeleton at the expense of its decreased inclusion into the bone tissue and augmented discharge from the organism. A 40.6% drop of Sr^{90} accumulation in the skeleton occurred under the influence of fluorine doses. No essential changes in the calcium level in the skeleton were found. (auth)

11409 COMPARATIVE STUDY OF THE BEHAVIOR OF THE SERUM COMPLEMENT OF THE BLOOD OF PATIENTS WITH NEOPLASMS SUBMITTED TO CONVENTIONAL RADIOTHERAPY AND TO HIGH ENERGY IRRADIATION. B. Bellion, F. Balzola, S. Chiarle, G. Piancino, and L. Resegotti (Università, Turin). Minerva nucleare, 5: 289-91(Nov. 1961). (In Italian)

The serum complement was investigated in ten patients undergoing conventional radiotherapy for various types of malignant tumors. C′ was considerably increased in all cases before treatment and decreased after 2000 roentgen units, to increase again, without returning to the initial values, after 4000 roentgen units. These results were compared with those observed in patients with tumors treated with betatron-therapy in which radiation treatment determined a continuous and considerable increase in C′. The mechanism by which ionizing radiations influence the complement titer of the serum is discussed, and the importance of the opposite effects of different types of radiations is stressed. (auth)

11410 CALCULATION OF THE PULMONARY TRANSFER FUNCTION FROM RADIOCARDIOGRAPHIC DATA. A. Rescigno and G. Segre (Università, Turin). Minerva nucleare, 5: 296-8(Nov. 1961). (In Italian)

Assuming that the right and the left heart behave as two mixing volumes, it is possible to calculate the pulmonary transfer function from the radiocardiographic findings. It is indicated by $x_a(s)$ and $x_b(s)$ the Laplace transforms of the functions $X_a(t)$ and $X_b(t)$ expressing the tracer activity in the right and in the left heart, by p(s) the pulmonary transfer function, and by K_a and K_b the fractional outflow from the right and from the left heart, then $x_b(s) = x_a(s) \cdot p(s) \cdot (K_a/s + K_b)$. By two successive "deconvolutions", from curve $X_b(t)$ it is possible to obtain the "pulmonary weighting function" $P(t) = L^{-1} p(s)$, which corresponds to the probabilistic distribution of the "random walk" in the pulmonary circulation. Examples of such a calculation and of function P(t) are reported and discussed. (auth)

11411 RADIOCARDIOGRAMS AND MEASUREMENT OF THE PULMONARY CIRCULATION TIME. L. R. Rosaia. Minerva nucleare, 5: 299-301(Nov. 1961). (In Italian)

The various methods proposed for measuring the pulmonary circulation time are discussed, and it is concluded, in agreement with other workers, that a system formed by a series of tubes of different lengths in which no admixture takes place, i.e. in which the flow is laminar, can offer a satisfactory explanation for the chronological relationships between the two waves in the normal human radiocardiogram and sufficient data for measurement of the mean pulmonary circulation time. Such a model, however, does not exclude the possibility that the pulmonary blood flow is a laminar flow through a system of tubes, which requires the same time in each tube, and in which the distribution of the tracer at its exit from the right ventricle is maintained throughout. This is in agreement with the still widespread opinion that the blood flow through the lungs requires approximately the same time in each vessel. Such a second model offers certain data for measurement of the mean pulmonary circulation time. (auth)

11412 BILIARY EXCRETION OF Ce^{144} IN THE RAT. N. Castellino (Università, Naples). Minerva nucleare, 5: 310-11(Nov. 1961). (In Italian)

It was shown that Ce is excreted almost entirely through the bile and that Ce^{144} in the bile is bound to protein compounds. (auth)

11413 DISCRIMINATION BETWEEN STRONTIUM AND CALCIUM IN THEIR PASSAGE FROM DIET TO THE BONE OF ADULT MAN. J. D. Burton and E. R. Mercer (Agricultural Research Council Radiobiological Lab., Wantage, Berks, Eng.). Nature, 193: 846-7(Mar. 3, 1962).

The ratio of stable Sr to Ca is tabulated for many foods in U.K., and the mean ratio in the national diet is calculated to be 1.33 mg/g. The ratio of stable Sr to Ca in the bone of adults in U.K. is calculated from the literature to be 0.31 ± 0.0087, and the human bone/diet ratio is therefore 0.23, which is in close agreement with other estimates based on less extensive data. Possible errors are discussed. (D.L.C.)

11414 DISTRIBUTION OF COLLOIDAL Au-198 AFTER INTRAVENOUS OR INTRAPERITONEAL ADMINISTRATION IN THE C57 BL MOUSE RECEIVING CYSTEAMINE BY MOUTH. E. P. Malaise and D. J. Mewissen (Université, Liège). Radiobiol. Latina, 4: 11-31(Jan.-Mar. 1961). (In Italian)

Observations on the distribution of radioactive gold indicate that mortality is an inadequate criterion for showing the beneficial effect of a radioprotective substance such as cysteamine on the radiotoxicity of Au^{198}. Since the distribution of Au^{198} is unaffected by the administration of cysteamine, the dose of radiation absorbed by each organ is the same in control mice as in those receiving oral cysteamine. Since each organ taken individually absorbs a

definite dose of radiation whether or not the animal has received oral cysteamine, a study of the restitution of certain organs, using their weight as a measure, is indicated. It should thus be possible to determine any protective effect of cysteamine. (auth)

11415 THE EFFECT OF EXPERIMENTAL RICKETS ON THE ELIMINATION OF RADIOSTRONTIUM FROM THE RAT SKELETON. Ugo Meldolesi and Salvatore Privitera (Università, Catania, Italy). Radiobiol. Latina, 4: 43-9 (Jan.-Mar. 1961). (In Italian)

The influence of the rachitogenic diet of Steenbock and Black on the elimination of Sr^{89} from the skeleton was studied in rats. Elimination of Sr^{89} was slowed down after the induction of rickets, while at the same time hypoplasia and hypertrophy of the skeleton contributed to increasing radiation damage to the bone marrow. The usefulness of the results in evaluating the seriousness of any contamination with radiostrontium and the therapeutic possibilities is stressed. (auth)

11416 INVESTIGATION ON THE MODE OF ACTION OF THE SO-CALLED "DETECTORS OF LATENT RADIOLESIONS". [PART] I. C. Monetti, A. Corinaldesi, and I. Paoletti (Università, Bologna). Radiobiol. Latina, 4: 51-74(Jan.-Mar. 1961). (In Italian)

X-ray therapy alone and in combination with various isotonic solutions was used in treating mammary tumors in mice. The different components of the solutions were successively replaced in an effort to establish the therapeutic contribution of each. (D.E.B.)

11417 INVESTIGATION ON THE MODE OF ACTION OF THE SO-CALLED "DETECTORS OF LATENT RADIOLESIONS". [PART] II. C. Monetti, A. Corinaldesi, and I. Paoletti (Università, Bologna). Radiobiol. Latina, 4: 75-86(Jan.-Mar. 1961). (In Italian)

Hypo- and hypertonic solutions were combined with x radiation in the therapy of mammary tumors in mice. The results were compared with those obtained previously using isotonic solutions. The comparison indicates similar behavior for all tested solutions. (D.E.B.)

11418 BERYLLIUM AND THE GROWTH OF BUSH BEANS. Evan M. Romney, James D. Childress, and George V. Alexander (Univ. of California, Los Angeles). Science, 135: 786-7(Mar. 9, 1962).

Beryllium in nutrient solution inhibited the growth of bush beans. The initial symptom was retarded root development. Although severe stunting of plants occurred, the foliage retained normal color. Roots accumulated beryllium. Increased beryllium concentrations decreased calcium in roots, stems, leaves, and fruits, and also decreased magnesium in roots and stems. Phosphorus was slightly increased in stems, leaves, and fruit. (auth)

11419 ZINC-65 LEVELS IN OYSTERS IN THE THAMES RIVER (CONNECTICUT). B. W. Fitzgerald, J. S. Rankin, and D. M. Skauen (Univ. of Connecticut, Noank). Science, 135: 926(Mar. 16, 1962).

Levels of Zn^{65} in oysters from selected sites in the Thames River (Connecticut) were determined for a 12-month period. The highest levels of radioactivity were in oysters from a bed situated opposite the United States submarine base in March 1961 (1637 micromicrocuries per kilogram of moist tissue). None of the samples assayed showed sufficient amounts of radioactivity to represent a health hazard. (auth)

11420 VYVEDENIE IZ ORGANIZMA NEKOTORYKH RADIOAKTIVNYKH VESHCHESTV. (Removal of Radioactive Elements from Organisms). A. A. Gorodetskii, T. P. Sivchenko, O. A. Khomutovskii, and E. Z. Ryabova. Kiev, State Publishing House of Medical Literature, 1959. 199p.

Experimental studies of the rapid excretion of P^{32}, Sr^{89}, Ca^{45}, and Cs^{134} from an organism are described. Applications of preparations for speeding the excretion of deposited radioactive materials were analyzed, and their efficiency in radiation sickness varified. 85 references are included. (R.V.J.)

Fallout and Ecology

11421 DEMONSTRATION AND MEASUREMENT OF Pu^{239} IN PLANTS. F. Ludwieg (Biologische Bundesanstalt für Land- und Forstwirtschaft, Berlin-Dahlem). Atompraxis, 8: 57-8(Feb. 1962). (In German)

Plutonium, which is present in varying quantities in radioactive fall-out from atomic bombs, descends on plants in the form of precipitation or dust. Measurements made in hay samples from 1954 to 1960 showed that Pu^{239} was present in amounts of up to 5 pc per 100 g. For measuring the Pu^{239} content, the hay was burned, the ash dissolved, and the plutonium removed with practically no residue. Detailed instructions for determining Pu^{239} in plant foods, and feedstuffs produced from them are given. (auth)

11422 ENVIRONMENTAL CONTAMINATION WITH IODINE-131 IN JAPAN. Noboru Yamagata and Kiyoshi Iwashima (Inst. of Public Health, Tokyo). Nature, 193: 892(Mar. 3, 1962).

Measurements were made on the radioactivity of the environment of Japan since October 1961, after the recent Soviet resumption of nuclear bomb tests. The maximum I^{131} concentration in air was 2.07 $\mu\mu c/m^3$ on Nov. 6, but it dropped to less than 0.2 $\mu\mu c/m^3$ in Dec. Results of analysis of lungs from cattle and man for I^{131} are tabulated. Spinach and milk analyses show that the major source of I^{131} contamination of the human body is leafy vegetables. Thyroid and urine analysis results are summarized. (D.L.C.)

11423 RADIOACTIVE CONTENT OF SOME CATTLE THYROIDS FOLLOWING THE RECENT RUSSIAN NUCLEAR TESTS. P. J. Gillespie (Northern Ireland Radiotherapy Centre, Belfast). Nature, 193: 892-3(Mar. 3, 1962).

Activity measurements were carried out on thyroid glands from heifers which were removed from pasture 1 to 2 days previously and killed 3 days after the date of maximum fall-out (Nov. 1961, Northern Ireland). The activity ranged from 5.6 to 31 $\mu c/kg$ and was identified as I^{131}. Geiger counter and scintillation scans of the neck of a young person handling the thyroids did not reveal any activity ascribable to the cattle thyroids. (D.L.C.)

11424 RADIOACTIVITY OF ALGAE IN THE ADRIATIC AND BLACK SEAS. G. G. Polikarpov and V. P. Parchevskii. Okeanologiya, 1: 338-9(1961).

A study of the alga Cystoseira barbata was made to determine its capacity to absorb various radioisotopes from sea water and collect data on the content of radioactive products in these algae from the Adriatic and Black Seas. 1959 tests revealed a radioactivity of 3 to 5 times the normal level, with no differences between the two seas. Tests in 1960 revealed a return to normal levels (at least for cerium-144 and praseodymium-144). (OTS)

Radiation Effects on Living Tissues

11425 (A/AC.82/G/L.717) THE EFFECT OF RADIATION DOSE RATE UPON THE PRODUCTION OF EYE

COLOUR MUTATIONS IN THE CHALCID DAHLBOMINUS. W. F. Baldwin (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 15, 1961. 12p.

Studies were carried out to determine whether or not an effect of dose rate on yield of radioinduced eye-color mutations could be found in oogonial cells of the insect Dahlbominus. Acute exposures to 1000 r (at 1000 r/min) were given to groups of sawfly cocoons containing Dahlbominus larvae on the 5th, 7th, and 9th days after propagation at a target-to-specimen distance of 40 cm. Chronic exposures to 1000 r at 10 r/hr were carried out continuously over a hundred-hour period from 5 to 9 days using a Co^{60} source. The accumulated results from the acute and chronic exposures showed that the rate of mutation from the acute exposures was slightly higher, but the difference was not statistically significant. The number of spontaneous mutations in males from unirradiated virgin females was extremely low. An increase in mutation rate of approximately 35-fold resulted from the irradiation. (M.C.G.)

11426 (A/AC.82/G/L.731) A SHIFT OF SEX-RATIO IN THE PROGENY FROM IRRADIATED MALES IN DROSOPHILA MELANOGASTER (PRELIMINARY NOTE). D. Moriwaki, I. Tobari, O. Kitagawa, S. Ohba, Y. Tobari, H. Ikeda, and H. Ichida (Tokyo Metropolitan Univ.). Dec. 1961. 4p.

The sex-ratio changes in the progeny of males irradiated at different stages of the germ cells in Drosophila melanogaster were investigated. Using the isogenic Oregon-R wild strain, male flies of 4 ± 2 hr-old were irradiated with 1000 r, 2000 r, and 3000 r and were crossed with the same wild type females of about 3 days-old. The sex-ratio changes were found to be dependent on the dose as well as the germ cell stage. The sex-ratio shifted to the lowest level in the group where progenies came from males of 6 to 8 days after irradiation. Each class sex-ratio was depressed in proportion to dose and the coefficient was 0.0237 per 1000 r on the average. (M.C.G.)

11427 (A/AC.82/G/L.734) MUTATION RATES AT LOW LEVEL IRRADIATION IN DROSOPHILA MELANOGASTER. (A Preliminary Report). Toshio Shiomi, Eiichi Inagaki, Hiroko Tachibana, and Yoshio Nakao (Japan. National Inst. of Radiological Sciences, Tokyo). Dec. 1961. 7p.

Preliminary results of studies in Drosophila melanogaster led to the conclusion that there is a linear relation between mutation rates and radiation dose down to 8 r. Sex-linked recessive lethal mutations were used as indicators of mutation induction. No evidence was seen of a threshold dose in genetic effect for doses of x radiation down to 8 r. (C.H.)

11428 (ANL-6464) BIOLOGICAL AND MEDICAL RESEARCH DIVISION SEMI-ANNUAL REPORT, JANUARY THROUGH JUNE 1961. (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-eng-38. 166p.

Separate abstracts were prepared on 29 sections of this report. (C.H.)

11429 (ANL-6464(p.5-11)) EFFECTS OF AGING AND/OR CHRONIC IRRADIATION ON CELL DIVISION IN THE CRYPTS OF THE MOUSE SMALL INTESTINE. Samuel Lesher, George A. Sacher, R. J. M. Fry, and Henry I. Kohn (Argonne National Lab., Ill.).

It has been shown that the movement of cells from the crypts to the extrusion zone at the tip of the villus is slower in old mice. The slowness of movement is due to a lengthening of the generation cycle of the rapidly-dividing cells of the crypts. The generation time is essentially the same at all levels of the small intestine but is longer in both the colon and the esophagus. The generation time of the duodenal crypt cells of BCF_1 mice exposed to 12 r/day gamma irradiation for 200 days starting at 100 days of age is approximately 3 hr shorter than that of 300-day-old unirradiated controls. The results suggest that the difference in generation time is due to differences in the duration of S and/or G_1 stages. (auth)

11430 (ANL-6464(p.12)) RECOVERY OF LEUKOCYTES FOLLOWING A SINGLE SUBLETHAL EXPOSURE OF MICE TO FISSION NEUTRONS. Howard H. Vogel, Jr., Nicholas Bink, and Richard Barhorst (Argonne National Lab., Ill.).

Thirty-two female mice were irradiated with a single, whole-body dose of fission neutrons. The total number of leukocytes was counted daily and compared with similar counts from unirradiated control mice. Results indicate that the total leukocyte count remained severly depressed for at least 3 weeks after neutron exposure. (C.H.)

11431 (ANL-6464(p.13-14)) PROGRESS REPORT: FURTHER EXPERIMENTS IN CHEMICAL PROTECTION IN NEUTRON-IRRADIATED MICE. Howard H. Vogel, Jr., Norman A. Frigerio, and Donn L. Jordan (Argonne National Lab., Ill.).

A series of derivatives of mercapto compounds and thiols were tested for their protective effects in mice when given before exposure to 1100 rads of Co^{60} γ rays or 350 rads of fission neutrons. None of the chemicals tested proved to be an efficient protector of neutron-irradiated mice although all had been found to reduce the effective dose of x radiation. (C.H.)

11432 (ANL-6464(p.15)) PROGRESS REPORT: LONGEVITY OF MICE WHOSE MOTHERS RECEIVED SINGLE WHOLE-BODY IRRADIATION WITH FISSION NEUTRONS. Howard H. Vogel, Jr. and Donn L. Jordan (Argonne National Lab., Ill.).

No significant difference was found in 400-day, cumulative mortality between the weaned progeny of irradiated female mice and the weaned progeny of their nonirradiated controls. After 400 days, 92.5% of the progeny of the irradiated females and 91% of the progeny of unirradiated controls were alive. (auth)

11433 (ANL-6464(p.16-18)) FACTORS AFFECTING RESISTANCE TO INFECTION IN YOUNG AND OLD MICE. E. J. Ainsworth and Robert L. Straube (Argonne National Lab., Ill.).

Preliminary results are reported from studies of the comparative susceptibility of old and young mice to induced infection. A general tendency was noted for tissue samples from old animals to contain viable organisms for a longer times after injection of bacteria than samples from younger animals. Data are tabulated on peripheral leukocyte counts after the injection of pyrogen. (C.H.)

11434 (ANL-6464(p.19-21)) UNUSUAL HEMATOCRIT FINDINGS IN CAPILLARY BLOOD OF X-IRRADIATED MICE. Robert N. Feinstein, Marilyn Vetter, and Carla Folkers (Argonne National Lab., Ill.).

Data are tabulated from studies of comparative effects of whole-body x irradiation on hematocrits of mouse capillary and peripheral blood. No significant differences were found between irradiated mice and controls. (C.H.)

11435 (ANL-6464(p.22-3)) MARROW CELL QUANTITATION: THE POSTIRRADIATION SPLEEN RESPONSE. Robert L. Straube, E. J. Ainsworth, and Harvey M. Patt (Argonne National Lab., Ill.).

Young female mice, identical in body weight, were given 800 r whole-body x irradiation, followed by intravenous in-

jection of varying numbers of marrow cells 24 hr later. Femoral marrow from either female mice or male rats was used. Ten days after irradiation the recipients were sacrificed and the spleens weighed. Examination of the spleens showed that a higher concentration of heterologous than isologous marrow cells was necessary to elicit a given splenic response. (C.H.)

11436 (ANL-6464(p.24-31)) USE OF THE NEWTON-RAPHSON METHOD IN DETERMINING LEAST SQUARE CONSTANTS UNDER SEVERAL EMPIRICAL MODELS. Merlin H. Dipert and Sylvanus A. Tyler (Argonne National Lab., Ill.).

Methods are reviewed for the statistical description of certain nonelementary models that are frequently used to represent biological phenomena. General fitting methods that are applicable to nonlinear models that can be programmed for electronic computers are discussed. The use of the Newton-Raphson Method is recommended in determining least square constants under the multihit model, the Compertz model, a growth model, and a two-variable regression model with both variables subject to error. These models were programmed for the IBM 650 and 1620 electronic computers. (C.H.)

11437 (ANL-6464(p.32-7)) RADIATION INDUCED RADIORESISTANCE. S. Phyllis Stearner, Sylvanus A. Tyler, Margaret H. Sanderson, and Emily J. Christian (Argonne National Lab., Ill.).

Preliminary results are reported from experiments involving the effects of protracted conditioning irradiation on initial radioinduced mortality in the chick. Results are summarized from studies on the significance of high-rate and protracted exposures for induced resistance to mortality 3 to 6 days after irradiation. (C.H.)

11438 (ANL-6464(p.38-49)) THE TOXICITY OF RADIOISOTOPES IN DOGS: STATUS IN QUO. Mirian P. Finkel, Birute O. Biskis, Robert J. Flynn, Isabel L. Greco, and Patricia Bergstrand-Jinkins (Argonne National Lab., Ill.).

Findings to date are summarized from experiments in progress since 1945 on the toxicity of certain radioisotopes in dogs. Data are tabulated on the effects of single injections of Pu^{239}, Sr^{89}, Sr^{90}, and Ca^{45}, exposure in utero to Sr^{89} and Sr^{90}, continuous exposure to Sr^{90}, partial-body exposure to Sr^{90}, and supralethal exposure to Sr^{90}. (C.H.)

11439 (ANL-6464(p.50-71)) PROGRESS REPORT: TOXICITY AND METABOLISM OF RADIONUCLIDES IN DOGS. [PART] I. William P. Norris, Louise S. Lombard, Carl E. Rehfeld, and Thomas W. Speckman (Argonne National Lab., Ill.).

Preliminary results are reported from studies on the toxicity and metabolism of Ce^{144} and Cs^{137} in dogs. Data on tissue distribution, retention, and pathological effects are tabulated. (C.H.)

11440 (ANL-6464(p.72-4)) CANONICAL DISTRIBUTIONS OF CELL DIVISION. Herbert E. Kubitschek (Argonne National Lab., Ill.).

The coefficients of variation of cell generation rate were examined for Tetrahymena geleii, diploid Saccharomyces cerevisiae cells, haploid Saccharomyces cerevisiae cells, HeLa cells, and Escherichia coli in culture at various temperatures. The possibility of canonical distributions of cell division is discussed. (C.H.)

11441 (ANL-6464(p.75-6)) THE STUDY OF NORMAL VARIATION. I. INTERRELATIONS OF ADIPOSITY, ANCESTRY, AND BLOOD TYPE IN MAN. Herman M. Slatis and Asher J. Finkel (Argonne National Lab., Ill.).

A study on the genetics of man was expanded into an investigation of those normal genes of which more than one allelic form occurs commonly in man. Data on height, weight, and blood group were analyzed for a group of 3,000 largely unrelated adult men and about 700 women. Rh type and month of birth do not appear to be related to height and weight. Environmental effects of year of birth and place of birth on height appear quite strong. No major effects of blood group genes on height or weight were observed. (C.H.)

11442 (ANL-6464(p.77-81)) PSEUDOMONAS PYROGEN AND RADIATION PROTECTION. E. J. Ainsworth (Argonne National Lab., Ill.).

Results are reported from studies on the protection against radiation injuries in mice afforded by a bacterial pyrogen of low toxicity derived from a Pseudomonas organism. Data are tabulated on the survival of Co^{60} γ-irradiated mice treated with Pseudomonas pyrogen or typhoid vaccine, and the effect of pyrogen pretreatment on x-radiation mortality in mice. (C.H.)

11443 (ANL-6464(p.82-4)) PROGRESS REPORT: PLUTONIUM REMOVAL, TUMOR INCIDENCE STUDIES. [PART] II. Marcia W. Rosenthal, Joan F. Fried, Arthur Lindenbaum, and Jack Schubert (Argonne National Lab., Ill.).

Results are reported from studies on the effectiveness of treatment with diethylenetriaminepentaacetic acid on mortality and tumor incidence in plutonium-injected mice. Data are presented on results after 675 days. (C.H.)

11444 (ANL-6464(p.85-7)) PROGRESS REPORT: EXPERIMENTAL STUDIES ON THE Cu(I,II)–PEROXY THEORY OF RADIOBIOLOGICAL EFFECTS AND THEIR MODIFICATION. I. BIOLOGICAL STUDIES. Jack Schubert and Joan Fried. II. BIOCHEMICAL STUDIES. Jack Schubert and William M. Westfall (Argonne National Lab., Ill.).

A series of experiments was conducted to evaluate the effect of a number of compounds on the survival of x-irradiated rats and mice. Results are reported for compounds effecting cytochrome oxidase inhibition by means of complex formation with the Cu(I) component of this enzyme, including D and L forms of penicillamine, malonitrile, and sodium cyanide. Results were evaluated on the basis of a significant shift in the per cent survival. Some tertiary amines and their related compounds, known to be peroxide scavengers, were also tested. These include trimethylamine oxide, trimethylamine chloride, tetraethylethylenediamine, and the calcium disodium forms of both ethylenediaminetetraacetic acid (EDTA) and diethylenetriaminepentaacetic acid (DTPA). The only one of these compounds that showed any protective activity was $CaNa_2$ EDTA given before irradiation. Main findings are summarized. (C.H.)

11445 (ANL-6464(p.88-9)) PROGRESS REPORT: BIOCHEMICAL STUDIES OF CELL ORGANELLES. SOLUBLE PROTEINS OF NUCLEAR AND CYTOPLASMIC FRACTIONS FROM RAT LIVER. A. D. Barton and Anna Kane Laird (Argonne National Lab., Ill.).

Progress is reported in studies on the influence of the nucleus on the activities of cells. The soluble proteins from rat liver nuclei isolated by sedimentation in 75% sucrose were studied in moving boundary electrophoresis. Findings were compared with those from similar studies on supernatant proteins and proteins extracted by saline from mitochondria and microsomes. Electrophoretic patterns and chromatographic characterists of the proteins are discussed. (C.H.)

11446 (ANL-6464(p.90-2)) MODIFICATION OF AN AUTOMATIC COUNTER. William J. Eisler (Argonne National Lab., Ill.).

Design modifications are described for an automatic sample changer for use in counting low-level samples of radioactive material with a gas flow Minirator installation. (C.H.)

11447 (ANL-6464(p.93-6)) STUDIES ON THE PHYSIOLOGICAL EFFECTS OF DEUTERIUM OXIDE. XII. THE EFFECT OF CYCLOPHOSPHAMIDE ON TUMORS IN DEUTERIATED MICE. Asher J. Finkel, Dorice M. Czajka, and Joseph J. Katz (Argonne National Lab., Ill.).

Progress is reported in studies on the possible enhancement of the antitumor effect of deuterium oxide by combination therapy with anticancer drugs. Results are reported of preliminary studies with cyclophosphamide in mice. (C.H.)

11448 (ANL-6464(p.97-9)) STUDIES ON THE PHYSIOLOGICAL EFFECTS OF DEUTERIATED METABOLITES. I. TOLERANCE AND TOXICITY OF DEUTERIO-GLUCOSE. Asher J. Finkel, Vallury S. Mohan, Dorice M. Czajka, Joseph J. Katz, and Henry L. Crespi (Argonne National Lab., Ill.).

Deuterio-glucose was extracted from algae grown in 99.6% D_2O. This material is a white crystalline substance, readily soluble in water, in which the hydrogen in non-exchangeable positions has been replaced by deuterium. Standard glucose tolerance tests were conducted in mice in order to ascertain whether the deuterio-glucose is removed from the blood stream at the same rate as ordinary glucose and also to determine if this material is more toxic than its natural counterpart. Results are reported on tests using ordinary glucose, C^{14}-labeled glucose, and deuterio-glucose. (C.H.)

11449 (ANL-6464(p.110-13)) PROPIONIC ACID METABOLISM. II. THE ISOMERIZATION OF METHYLMALONYL COENZYME A. Robert W. Swick and Geraldine Germek Moss (Argonne National Lab., Ill.).

The isomerization of methylmalonyl coenzyme A in the metabolism of propionic acid in propionibacteria is discussed. Results are reported from studies on the degradation of C^{14}-methylmalonyl CoA that indicate an asymmetric distribution of radioactivity in succinyl CoA. (C.H.)

11450 (ANL-6464(p.114-15)) SWELLING OF MITOCHONDRIA ISOLATED FROM LIVERS OF IRRADIATED RATS. John F. Thomson and Y. E. Rahman (Argonne National Lab., Ill.).

No consistent difference was observed between the swelling characteristics of liver mitochondria from normal rats and those from x-irradiated animals. (C.H.)

11451 (ANL-6464(p.116-27)) INCORPORATION OF 2-C^{14}-GLUTAMIC ACID INTO PEPTIDES AND PROTEINS OF CELL-FREE HOMOGENATES OF PEA SEEDS. James E. Turner (Argonne National Lab., Ill.).

Pea seeds contain ninhydrin-positive material that yields amino acids following hydrolysis with hydrochloric acid. In cell-free homogenates of pea seeds more glutamic acid is incorporated into this material during the first hour of incubation than into the bulk protein fraction. It is not possible at present to state whether this peptide material is subsequently incorporated into protein; however, the data are consistent with the hypothesis that peptides serve as intermediates in protein synthesis in pea seeds. (auth)

11452 (ANL-6464(p.128-32)) S-METHYLMETHIONINE AND S-ADENOSYLMETHIONINE HOMOCYSTEINE TRANSMETHYLASE IN HIGHER PLANT SEEDS. James E. Turner and Stanley K. Shapiro (Argonne National Lab., Ill.).

S-methylmethionine- and S-adenosylmethionine-homocysteine transmethylase activity was demonstrated in cell-free homogenates prepared from the seeds of lima beans, garden peas, corn, tobacco, sunflower, cabbage, and jack-beans. The reaction was followed through the use of donor molecules labeled with $C^{14}H_3$ groups and paper chromatograms of reaction mixtures followed by means of a recording scanner. Typical recordings are presented and findings are discussed. (C.H.)

11453 (ANL-6464(p.133-42)) ABSORBED DOSE IN EXTERNALLY IRRADIATED BIOLOGICAL SPECIMENS. I. Co^{60} GAMMA RADIATION. Warren K. Sinclair (Argonne National Lab., Ill.).

The average absorbed dose and the maximum and minimum absorbed dose received by biological specimens of varying size, irradiated laterally with a known exposure dose of Co^{60} γ-radiation measured in air at the midline was investigated experimentally. Spheres and cylinders covering a range of sizes, filled with ferrous sulfate dosimeter, were exposed to Co^{60} γ-radiation to determine the average dose. Maximum and minimum doses were measured using small plastic vials of dosimeter. Analysis of the exposure situation leads to a value for the absorption coefficient of Co^{60} γ-radiation in water of about 0.037 cm^{-1}. (auth)

11454 (ANL-6464(p.143-4)) CO_2 UPTAKE BY ROOTS OF XANTHIUM PLANTS. John Skok, William Chorney, and Wallace S. Broecker (Argonne National Lab., Ill.).

Seven-to-eight-week old xanthium plants were grown in a sealed double-chamber system that permitted isolating the top portion and the root portion in separate compartments. The roots were immersed in a complete nutrient solution and the lower root chamber was equipped with leads to permit the bubbling and recirculation of air with $C^{14}O_2$ through the root medium. Leads were also fixed to the upper leaf chamber to permit the recirculation of air or the modified atmosphere required for the experiment. The experiments were permitted to run for various periods of time, and at harvest the plants were divided into various fractions, oven-dried, ground, and assayed for activity. Results indicate that a very small amount of $C^{14}O_2$ was absorbed by the roots and the carbon distributed throughout the plant. The amounts of carbon incorporated were approximately 100 times less than the amount lost by root respiration. The possible significance of carbon obtained from root-absorbed CO_2 in the economy of plants is discussed. (C.H.)

11455 (ANL-6464(p.145-50)) PLASMA LACTIC DEHYDROGENASE AND WHOLE BODY X-IRRADIATION. R. N. Feinstein, Marilyn Vetter, and Carla Folkers (Argonne National Lab., Ill.).

In a single experiment, the whole-body x irradiation of a mouse with 1000 r, while not affecting the plasma lactic dehydrogenase (LDH) of the animal, was apparently responsible for the fact that the plasma of this animal, injected into normal mouse recipients, caused a repeatedly transmittable biochemical lesion characterized by elevated plasma LDH. A second experiment showed a somewhat similar phenomenon, quantitatively much less impressive. A further wide range of tests has failed to reproduce these results. It is at present suspected that the initial positive results may have been due to a Pseudomonas infection in the original mouse used. (auth)

11456 (ANL-6464(p.151-3)) PHTHALOCYANINE DERIVATIVES. Norman Frigerio, Erven Van Deventer, and Jerrold Paulis (Argonne National Lab., Ill.).

The chemical composition and properties of phthalocyanine were studied with the aid of a three-dimensional model. Deuterio-phthalocyanine was synthesized by the

metathesis of either dilithium phthalocyanine or of phthalocyanine with 100% D_2SO_4. The observation that phthalocyanine contains 2 imino and 16 benzenoid hydrogen positions in accord with the formula $H_2(C_8H_4N_2)_4$ was confirmed by nuclear magnetic resonance measurements of phthalocyanine tetrasulfonate in D_2O. (C.H.)

11457 (ANL-6464(p.154-9)) CARCINOGENESIS BY 2-ACETYLAMINOFLUORENE. III. RATE OF CELL PROLIFERATION VERSUS DOSE OF CARCINOGEN. Anna Kane Laird and A. D. Barton (Argonne National Lab., Ill.).

The carcinogenic effects of 2-acetylaminofluorene was studied in rats. Data on the rate of liver cell proliferation versus dose of carcinogen are presented graphically. A mathematical function is suggested that would satisfactorily fit the relations observed. (C.H.)

11458 (TID-14775) CYTOCHEMICAL AND ELECTRON MICROSCOPIC STUDIES OF RADIATION DAMAGE. Annual Progress Report and Renewal Proposal. Alex B. Novikoff (Yeshiva Univ., New York. Albert Einstein Coll. of Medicine). Jan. 17, 1962. Contract AT(30-1)-2786. 9p.

The effects of I^{131} injection were studied at 18 hr. to 8 days after injection. The effects of a single whole-body 5000-r dose were studied at 10 min. to 6 hr. The most evident changes appeared in the lyosomes. (T.F.H.)

11459 (TID-14970) THE EFFECT OF X-RADIATION ON LONGEVITY IN DROSOPHILA MELANOGASTER. Technical Progress Report. (Taylor Univ., Upland, Ind.). [nd.] Contract AT(11-1)-885. 26p.

Data are presented for the length of life post eclosion for control and irradiated groups of flies from a crossed strain. The amounts of radiation used were 25 r for eggs; 250 r for larvae; 250, 2,500, 7,500, and 15,000 r for imagoes. Both mated and unmated groups were studied. The results indicate that (1) irradiation lowers the life of imagoes, although inconsistent results were obtained for imagoes from irradiated larvae and eggs, and that (2) females outlive males in both irradiated and control flies. (D.L.C.)

11460 (TID-15042) THE EFFECT OF IRRADIATION ON THE LOCALIZING RESPONSE (TO ANTIGEN) OF DIFFERENT TISSUES IN IMMUNITY. Progress Report and Proposal to the Atomic Energy Commission [Covering Period], May 15, 1962–May 14, 1963. Arthur C. Curtis (Michigan. Univ., Ann Arbor). Jan. 1962. Contract AT(11-1)-70. 14p.

Focal X irradiation was found to impart an "anti-localizing" characteristic to an irradiated area as demonstrated by the injection of protein in that area. Focal irradiation prevented or reduced an inflammatory response to staphylococci injected in the irradiated area. The anti-localizing characteristic apparently permitted the organisms to escape from the irradiated area, thereby reducing the local inflammation. Focal irradiation of low (80) KVP and of high (260) KVP produced qualitatively different anti-localizing results following the injection of protein. Focal irradiation (80 KVP) of the hip of rabbits led to quantitatively different anti-localizing results to injected protein than did similar irradiation of the side of rabbits. Hip and side of non-irradiated rabbits showed quantitatively different localizing results to injected protein. If 500r instead of 1000r were employed, anti-localization of subcutaneously-injected protein was observed 6 and 12 hours post-irradiation, but not 24 hours after. If, after exposure to 1000r, protein was injected subcutaneously in the irradiated area 90 days after the exposure, the localizing response to the injected protein was found to be increased instead of decreased. If, after exposure of the skin of the hip of rabbits to 1000r, protein was injected in skeletal muscle within the irradiated area, a reduction in localization 24 hours after the irradiation was noted compared with that shown in non-irradiated controls. (auth)

11461 (TID-15047) THE OCCURRENCE OF CHROMOSOMAL ABERRATIONS IN PRE-SPERMATOCYTIC CELLS OF IRRADIATED MALE MICE. Progress Report [for] period February 1, 1961–January 31, 1962, and Fourth Renewal Proposal [for] period June 1, 1962–May 31, 1963. Allen B. Griffen (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Mar. 1, 1962. Contract AT(30-1)-2113. 22p.

Research designed to determine the nature and extent of radiation damage to the chromosome system of pre-spermatocytic cells was carried out. Male mice are being subjected to x-ray treatment of the testes, at three different radiation dosages. The treated individuals and suitable untreated controls are mated to females of standard inbred strains. All offspring produced by each male throughout the remainder of his life, but not exceeding 24 months, will be tested for the presence of chromosomal aberrations capable of producing semi-sterility. All semi-sterile lines will be analyzed cytologically. (auth)

11462 (TID-15060) RADIATION EFFECTS ON PLANTS. Progress Report, April 1, 1961–January 15, 1962. John D. Spikes (Utah. Univ., Salt Lake City). Jan. 15, 1962. Contract AT(11-1)-875. 26p.

The general gamma sensitivity of the photochemical activities of algae and of isolated chloroplasts was determined. Radiation was found to increase the respiratory loss of sugar from beets during the period between harvesting and processing. Chlorophyll a, chlorophyll b, and pheophytin a were irradiated and the pigment changes followed. Over the range of 0 to 32,000 r, destruction of the pigments appeared to be linear with dosage. Carbamate studies were extended to include comparative observations on Chlorella Hill reaction and photosynthesis. The effects of pressure on the photochemical oxygen evolution by isolated chloroplast preparation are being studied. Research is being carried out on the riboflavin-sensitized photoinactivation of trypsin. The significance of absolute configuration in optical rotation and in catalysis was determined. (M.C.G.)

11463 (TID-15084) EFFECT OF IONIZING RADIATION ON FOREST TREES — ITS GENETIC AND CYTOLOGICAL IMPLICATIONS. Progress Report, June 1, 1961–May 31, 1962. Francois Mergen (Yale Univ., New Haven. School of Forestry). Feb. 28, 1962. Contract AT(30-1)-2755. 11p.

Studies are being carried out to determine the effects of gamma radiation on the reproductive process of Pinus rigida and Quercus sp. Potted seedlings of Pinus rigida were placed in the Co^{60} radiation field. Buds were collected to follow the effect of radiation on the cytological development of the meristematic cells. Seedlings that received 3020 r were able to resume growth although in a much deformed condition. Low levels of gamma radiation increased the number of aborted pollen grains and pollen tube growth was also significantly reduced. Fertilization was delayed at a level of 4r/20 hr day. Chronic irradiation as low as 3r/20 hr day resulted in small cones and significantly lower germination percentages in seed lots. A germination of 75% was obtained from seed that had accumulated a total of 3250r at the rate of 3.6r/20 hr day. Acorns of two representative species of the Erythrohalanus and Lepidohalanus groups were subjected to acute radiation and planted.

Mature oak trees were exposed to low level (15r/day and less) irradiation. The oak species survived in an area where associated pitch pine trees died in response to the irradiation levels. (M.C.G.)

11464 (TID-15118) THE TUMOROGENIC ACTION OF BETA RADIATION ON THE RAT SKIN. Progress Report. Roy E. Albert (New York Univ., New York. Coll. of Medicine). 1962. Contract AT(20-1)-2785. 15p.

Progress is reported in studies on the mechanism of tumor formation by ionizing radiation using the induction of skin tumors in the rat by β radiation as an experimental model. The β ray sources were prepared by dipping filter paper in P^{32} isotope solution, blotting and drying the paper, and then inserting the sources in a thin plastic envelope. Dosage was measured with stacks of Dupont x-ray film processed in standard x-ray chemical developer and fixer solutions. Photographic density measurements across the exposed regions of film were done with the use of a Photovolt densitometer and a Leitz Ortholux microscope. Variations in the number, size, and shape of the irradiated areas was accomplished by interposing masks having suitable apertures between the skin and the β source. Data are presented graphically on the relation of tumor incidence to the size of the irradiated area of skin at given dose levels. (C.H.)

11465 (USNRDL-TR-532(Rev.)) ACCELERATED INDUCTION OF NEOPLASMS IN MOUSE KIDNEYS X-IRRADIATED (690 RAD) WHILE UNDERGOING COMPENSATORY HYPERPLASIA. V. J. Rosen and L. J. Cole (Naval Radiological Defense Lab., San Francisco). Oct. 11, 1961. 19p.

Groups of young adult (C57LXA)F_1 mice were subjected to different treatments including 690 rad whole-body x irradiation, unilateral nephrectomy and no irradiation, 690 rad irradiation followed by unilateral nephrectomy 1 hour later, unilateral nephrectomy followed by 690 rad irradiation 3 hours later, and unilateral nephrectomy, 690 rad 3 hours later. The mice were examined 1 year or 18 months later for kidney neoplasms. The group nephrectomized and irradiated 3 hours later showed a high incidence (10 out of 19) of kidney adenomas, as compared with none in the mice irradiated only, or nephrectomized only. A high incidence (11 out of 15) of tubular and Bowman's capsule proliferations was observed in the mice subjected to irradiation first and nephrectomy 1 hour later. These proliferations are considered to be early stages in the evolution of the frank renal adenoma. Since the accelerated induction of kidney neoplasms observed, occurred under conditions which inhibit mitotic activity and compensatory hypertrophy in the mouse kidney, it is proposed that the development of these renal neoplasms is the consequence of a prolonged imbalance between the stimulus to hyperplasia on the one hand, and the capacity for hyperplasia in radiation-altered kidney cells on the other. (auth)

11466 (USNRDL-TR-550) RESIDUAL INJURY CAUSED BY IRRADIATION WITH FAST NEUTRONS. J. S. Krebs and R. W. Brauer (Naval Radiological Defense Lab., San Francisco). Feb. 26, 1962. 25p.

The LD_{50} of C_3H female mice for fission-spectrum neutrons was found to be 274.5 ± 4.2 rad. The previously reported value in the same mice for 250 kvp x ray was 632 rad, giving an RBE of 2.30. Conditioning exposure of the mice to a total neutron dose of 482.3 ± 7.2 rad over an interval of 8 to 10 weeks resulted in lowering the LD_{50} for neutrons by 41.8 ± 5.9 rad, or 8.67 ± 1.23% of the total conditioning dose. The previously reported value in the same mice for 250 kvp x-ray was 9.58% of the conditioning dose. Continued exposure of the mice to 166 rad doses of neutrons at intervals of 4 to 5 weeks gave a median survival time of 22 weeks. This was greater than that produced by exposure to 420 rad and less than that produced by exposure to 280 rad of 250 kvp x ray given at the same time. It is concluded that the RBE of the mice for residual radiation injury and the RBE for chronic radiation tolerance over short time intervals are the same as that for acute injury tolerance. (auth)

11467 (AEC-tr-5016) SIMULATION OF GROWTH IN SINAPIS ALBA BY MEANS OF X-RAY IRRADIATION. Th. v[on] Kreybig and R. Schagen. Translated by Lydia Venters (Argonne National Lab., Ill.) from Atompraxis, 8: 6-7(Jan. 1962). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 8558.

11468 (JPRS-12393) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, 6: No. 8, (Aug. 1961). 148p.

This is a complete translation of the journal which was previously abstracted for NSA from the original language. (D.L.C.)

11469 (JPRS-12829) STUDIES IN PATHOLOGY. Translation of Arkhiv Patologii, 23: No. 12, 57-68(1961). 17p.

Two papers are included which respectively treat radiation effects on the sorptive properties of tissues and morphological changes in connective tissue capsules around plastic implants in rats during malignization. A separate abstract was prepared for the first paper. (D.L.C.)

11470 (JPRS-12829(p.1-6)) THE EFFECTS OF GAMMA-RAYS ON THE SORBTIVE PROPERTIES OF SOME TISSUES OF WHITE RATS UNDER CONDITIONS OF CHRONIC IRRADIATION. M. I. Fedotova. Translated from Arkh. Patol., 23: No. 12, 57-61(1961).

A study was made of the effects of chronic irradiation which do not produce acute radiation sickness on the dye sorptive properties of various rat tissues. Rats were subjected to daily gamma 30-r doses, and after total doses of 90 to 4,500 r, tissues from various organs were studied with a solution of neutral red. Significant changes from the control sorption values were observed. In the cerebral cortex tissues, sorption at first decreased but after 900 r exceeded the control. In the kidney and liver tissues, the sorption increased with dose. The greatest sorption increase was in the testes. Sorption changes in the muscles were not significant. It is concluded that sublethal radiation doses lead to alteration of cellular protein in different organs to different degrees. (D.L.C.)

11471 EFFECTS OF ULTRAVIOLET-IRRADIATED METHYL LINOLENATE ON CELL DIVISION AND RESPIRATION IN SACCHAROMYCES CEREVISIAE. Juergen Fraenz and B. Theodore Cole (Oak Ridge National Lab., Tenn.). Arch. Biochem. Biophys., 96: 382-5(Feb. 1962).

The effect of ultraviolet-irradiated methyl linolenate was studied in yeast. Water extracts of irradiated methyl linolenate stopped cell division for 4–6 hr, depending on the cell inocula. All inhibition disappeared within 12 hr. The endogenous respiration of yeast cells was increased by the irradiation products, while exogenous respiration was not affected. The specific nature of the irradiation products is not known. Four compounds could be separated on gas chromatograms. These compounds are more volatile than pure methyl linolenate. All four compounds give a red chromogen with thiobarbituric acid. This might be due to a peroxide group in these compounds. (auth)

11472 EFFECTS OF ARTIFICIAL Sr^{90} FALL-OUT ON PLANTS. II. RADIOBIOLOGICAL EFFECTS. E. G. Niemann (Technische Hochschule, Hanover). Atompraxis, 8: 51-6(Feb. 1962). (In German)

The uptake and distribution of artificial Sr^{90} fall-out in Arabidopsis thaliana L. over several generations is reported. The radiobiological effects of the fall-out were clearly demonstrable at a concentration of 1.5×10^{-9} c/m·d: stimulation of vegetative growth, retardation of blossom inception, and change in the number of leaf-gaps. These changes proved to be hereditary over several generations, even with no further application of fall-out. No singular radiation mutants were found. At a rough estimate, the minimum dose which produces demonstrable effects is approximately 1 rad/generation. It is possible that the isotope transformation effect is also involved in the low-dose effect observed. (auth)

11473 EFFECT OF TEMPERATURE ON THE RADIOSENSITIVITY OF RAT THYMOCYTES. D. K. Myers and R. M. Sutherland (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Biochem. and Physiol., 40: 413-17 (Mar. 1962). (AECL-1440)

A difference in radiosensitivity was demonstrated for mammalian thymocytes incubated in isotonic saline solutions at 37°C and at 25°C. It is concluded that the difference in radiosensitivity must reflect some qualitative difference in metabolism in thymocytes at these two temperatures. (C.H.)

11474 THE CYTOGENETIC EFFECT OF IONIZING RADIATION AND OF STREPTOMYCIN. L. V. Cherezhanova and N. P. Dubinin. Doklady Akad. Nauk S.S.S.R., 142: 208-10(Jan. 1, 1962). (In Russian)

Onion bulbs were treated with a streptomycin solution (5×10^{-3}γ/ml) and were irradiated with gamma rays (250 r) or with neutrons (30 rads). The data on the number of chromosome rearrangements show that streptomycin has a protective effect of 51% in the early stage of cell division, but that it has no protective effect on the middle and late interphase stages. The onion bulbs were treated with a streptomycin solution at different periods after irradiation and were fixed 24 hours after irradiation. The streptomycin showed a protective effect when administered within a few hours after irradiation, but the number of chromosome rearrangements increased when streptomycin was administered at 9, 12, 16, and 20 hours after irradiation. (TTT)

11475 THE INFLUENCE OF VARIOUS TYPES AND DOSES OF IRRADIATION ON THE PROTEIN COMPOSITION OF RABBIT'S BLOOD SERUM. M. A. Darakhvelidze (Scientific-Research Inst. of Roentgenology and Medical Radiology, Ministry of Public Health, Georgian SSR). Med. Radiol., 6: No. 11, 47-53(Nov. 1961). (In Russian)

The influence of diverse doses of external x ray and internal radiophosphorus irradiation, as well as the simultaneous action of both, on the blood serum protein composition were studied for a period of 4 months. It is inferred that an increase in the beta-fraction content of globulins is associated with more profound disturbances of protein metabolism and is indicative of the severity of affection, whereas an increase content of gamma-globulins is noted in animals with higher resistant to irradiation. (auth)

11476 THE EFFECT OF RADON ON THE TEMPERATURE OF INTERNAL ORGANS. V. A. Pegel and G. A. Dokshina (Tomsk State Univ., USSR). Med. Radiol., 6: No. 6, 54-8(Nov. 1961). (In Russian)

In chronic experiments on dogs with implanted thermocouples in the kidneys, liver, and spleen, assessment was made of their temperature upon the introduction to the blood of various quantities of radon (from 0.3 to 170 μc/kg). With the increase of radon and the duration of its presence in the organism, the temperature of the organs increases from 0.8 to 3°C. Along with the above, there is noted an augmenting disturbance of paralellism in temperature changes in the right and left kidneys, liver, and spleen, testifying to disturbed normal correlation of their functions; this is an index of developing intoxication of the organism. (auth)

11477 LATE OBSERVATIONS ON PERSONS SUBJECTED TO THE EFFECT OF RADIATION. M. P. Domshlak, Yu. G. Grigor'ev, N. G. Darenskaya, L. B. Koznova, G. F. Nevskaya, V. I. Nesterova, and N. Ya. Tereschenko. Med. Radiol., 7: No. 1, 10-16(Jan. 1962). (In Russian)

Observations of 218 persons at various periods (up to 10 yr) following therapeutic radiation treatments showed considerable functional disorders. Disturbances in vegetative-vascular and endocrine regulation, asthenovegetative syndrome, cerebroasthenic disorders, disturbances of electrophysiological activity of the cerebral cortex, changes in olefactory and gustatory analyzers, and changes in skin thermoregulation were observed. (R.V.J.)

11478 STUDIES OF CERTAIN ASPECTS OF THE PATHOGENESIS OF RADIATION INJURIES OF THE SKIN. A. V. Kozlova, V. B. Zairat'yants, N. P. Mordvinova, and I. B. Tsybul'skii. Med. Radiol., 7: No. 1, 16-20(Jan. 1962). (In Russian)

The clinical course of radiation ulcers that had existed for several months to 10 years, was studied in 57 patients. Subject to investigation was the action of various biogenic stimulators applied in the form of ointments on the ulcerous surface. In experiments staged on albino rats and guinea pigs, the terms of appearance of radiation ulcers following local irradiation in a dose of 3000 r were studied. It was noted that the radiation injury in the form of an ulcer is constantly attended by the presence of disturbed vascular permeability and infection in the region of affection. Amelioration of the ulcer and reduction of inflammatory manifestations are a prerequisite for epithelization. The healing of radiation ulcers is accompanied by structural reorganization of skin elements at the site of injury toward sclerosis. In the scar there is scanty development of vessels and nerves in the cicatricial tissue. (auth)

11479 THE INFLUENCE OF THERAPEUTIC DOSES OF IONIZING RADIATION ON THE CONTENT OF VITAMIN B_6 AND B_{12} IN THE BLOOD SERUM. M. M. Nivinskaya, V. P. Alferova, and K. P. Rogova (State Scientific-Research Inst. of Vitaminology, Ministry of Public Health, USSR). Med, Radiol., 7: No. 1, 41-5(Jan. 1962). (In Russian)

Data relative to the influence of radiation on the content of vitamin B_6 and B_{12} in the blood serum of oncological patients are given. It was impossible to determine the importance of the localization of the tumor, its histological structure, the stage of the disease, and the value of the dose in the range 4000 to 14000 r. A more frequent rise in the content of vitamins B_6 and B_{12} was observed in persons over 50 years of age and in those subjected to irradiation by Co^{60} in comparison with those x-irradiated. (auth)

11480 THE STATE OF ASCORBIC ACID EXCHANGE DURING THE ACTION OF X-RAYS ON THE ORGANISM. Z. Ya. Dolgova (Semipalatinsk Inst. of Medicine, USSR). Med. Radiol., 7: No. 1, 67-70(Jan. 1962). (In Russian)

Ascorbic acid exchange in organisms of guinea pigs subjected to single total x-irradiation in a dose of 600 r was

studied. The ascorbic acid content was determined in a number of internal organs and whole blood. An assessment was also made of the absorption capacity of proteins as an index of ascorbic acid saturation of organisms. A decreased level of ascorbic acid in the brain, adrenals, testes, spleen, small intestine, and whole blood was observed. Ascorbic acid absorption by blood proteins increases after irradiation as a result of reduced saturation of the organism. The data testify to the elevated requirement of ascorbic acid during the action of radiation. (auth)

11481 VARIATIONS OF THE RELATIVE SUPERFICIAL AND DEEP BIOLOGICAL EFFECTIVENESS OF RADIATIONS OF DIFFERENT ENERGY. G. Tori and G. E. Zarabini (Università, Bologna). Minerva nucleare, 5: 292-4(Nov. 1961). (In Italian)

The introduction of high energy radiations has given rise to the complex problem of the evaluation of the relative biological effectiveness of radiations of different wave lengths. The lethality on the 30th day was investigated in rats irradiated with radiations of different wave lengths (200 kev x rays and 1.2 Mev gamma rays of Co^{60}), in air and during immersion in water (10 cm below the surface). The following results were observed: the percent lethality decreases considerably with 200 kev x rays when irradiation in water is substituted for irradiation in air, whereas the decrease is much less notable with Co^{60} gamma rays. This suggests that the biological effectiveness of 200 kev radiations varies considerably according to whether it is measured at the surface or not. The relative biological effectiveness of Co^{60}, under the same conditions, also varies, but to a much lesser extent. This different behavior of the relative biological effectiveness of 200 kev radiations and Co^{60} could be explained by the different phenomena caused by the interaction of radiations and matter superficially and deeply. It seems certain that, of the various factors in the variability of the relative biological effectiveness, the depth at which the biological reagent considered is situated must be kept in mind. This may prove significant in radiotherapy. (auth)

11482 POSSIBILITIES OF DEVELOPING SOME LATENT LESIONS IN LIVER CELLS. M. Laddaga and U. Romagnoli (Università, Bologna). Minerva nucleare, 5: 294-5(Nov. 1961). (In Italian)

It was shown that the classical histologic methods are unable to reveal the presence of cellular changes in the irradiated liver, even after considerable doses of radiations. By inducing a mitotic crisis at different intervals (up to 256 days) after irradiation by means of partial hepatectomy, two types of cellular injury were observed. The first consists in temporary inhibition of the mitoses, the second in the formation of abnormal mitoses. These represent two latent effects which are the expression of a cellular change and could be used to evaluate the true entity of liver injury. (auth)

11483 EFFECT OF γ-RADIATION ON ABILITY OF ISOLATED CHLOROPLASTS TO REDUCE FERRICYANIDE IN PRESENCE OF LIGHT. Richard M. Roppel and William R. Meagher (Battelle Memorial Inst., Columbus, Ohio). Nature, 193: 893-4(Mar. 3, 1962).

Samples of lyophilized chloroplasts isolated from kidney bean seedlings were irradiated with Co^{60} gamma rays to total doses of 4×10^5 to 6.5×10^6 rep. The chloroplasts were then assayed for ability to reduce ferricyanide in the presence of light by measurements of the change in the redox potential of the ferricyanide solution. The results are interpreted in terms of radiobiological target theory. (D.L.C.)

11484 EFFECT OF HIGH DOSE LOCAL IRRADIATION ON THE BASIC SUBSTANCE OF THE DERMAL CONNECTIVE IN HIBERNATING ANIMALS (HISTOCHEMICAL RESEARCH). A. Cavina Pratesi, M. Martinazzi, and G. R. Bandirali (Università, Pavia, Italy). Radiobiol. Latina, 4: 33-41(Jan.-Mar. 1961). (In Italian)

By means of a histochemical method based principally on metachromasia, studies were made of the variation in the interstitial mucopolysaccharides of the skin (on which diffusion essentially depends) in animals irradiated locally with doses of 5000 to 15000 r during hibernation and when awake. In previous investigations, less pronounced diffusion of liquids injected into the skin was in fact observed in animals irradiated while hibernating. It was observed that the weakening of the metachromatic reaction is appreciably less marked in animals treated during hibernation and concluded that the direct effect of x rays was less intense during hibernation. (auth)

11485 RADIO-EPIDERMOLYSIS REPAIRS ONLY THROUGH SURVIVAL OF EPIDERMAL ELEMENTS OR THEIR EARLY GRAFTING. L. Bosio (Instituti Clinici di Perfezionamento Padiglione Mutilati del Viso, Milan) and A. Isola. Radiol. med., 47: 1121-36(Dec. 1961). (In Italian)

Scrupulous preservations of the basal layer or, at least, in the severe states, of the residual epidermal islands, essential to epithelization of radio-epidermolysis were investigated. The destruction of these, due to errors in medical treatment, cause transformation of the original superficial lesion (epidermal) into a no longer spontaneously curable deep lesion (dermal). In order to avoid this complication (that is, chronic inflammation of the uncovered derma exposed to infection, deterioration of the vascular lesions, frequent necrotic ulcerations, or the rarer recovery in slow, painful, and poorly resistant selerosis) it is necessary to contribute new epithelial or epidermal elements by means of free grafts in order to quickly reconstruct the missing epidermal protection of the treated zone. It was concluded that in correct treatment of cutaneous radiolesions epidermolysis marks the extreme limit of medical treatment and the start of surgical treatment. (auth)

11486 THE EFFECT OF ULTRAVIOLET LIGHT ON SOME COMPONENTS OF THE NUCLEIC ACIDS. VI. THE ORIGIN OF THE U. V. SENSITIVITY OF DEOXYRIBONUCLEIC ACID. R. Beukers, J. Ijlstra, and W. Berends (Technological Univ., Delft, Netherlands). Rec. trav. chim., 79: 101-4(Jan. 1960). (In English)

A rapid decrease in extinction of deoxyribonucleic acid in the first moments of irradiation with uv light (2537 Å) is due to the conversion of the pyrimidines into low-absorbing substances. Thymine in this natural polymer reacts according to the so-called first irreversible reaction shown by the free bases in solution. This could be demonstrated by means of a peculiar property of the irradiation product of thymine. Cytosine is supposed to react in the same way. The importance of this finding with respect to the lethal action of uv light on micro-organisms is discussed. (auth)

11487 HOMOGRAFT REACTION IN MICE: EFFECT OF URETHANE AND SUBLETHAL X-RADIATION. L. J. Cole and W. E. Davis, Jr. (Naval Radiological Defense Lab., San Francisco). Science, 135: 792-3(Mar. 9, 1962).

Combined treatment of mice with urethane (a nucleic acid antagonist and mitotic inhibitor) plus sublethal x radiation (500 rad) suppresses the homograft response to a degree considerably greater than that observed with this dose

of x rays alone. Thus, LAF_1 mice receiving two injections of urethane plus 500 rad of x radiation prior to grafting retained C_3H mouse skin grafts for periods up to 60 days, with a mean graft survival time of 40 days, as compared with 18 days for mice exposed to 500 rad only. (auth)

Radiation Sickness

Refer also to abstracts 11431, 11435, 11442, and 11444

11488 (JPRS-12480) BASIC MECHANISMS OF REACTION OF THE NERVOUS SYSTEM DURING ACUTE RADIATION SICKNESS. I. S. Glazunov, A. K. Gus'kova, and M. N. Livanov. Translated from Zhur. Nevropatol. i Psikhiatrii im. S. S. Korsakova, 61: 1574-8(1961). 10p.

An analysis is presented of the manifestations in the nervous system during general exterior irradiation with doses not exceeding 1,000 v. (J.R.D.)

11489 EFFICIENCY OF DITHIOCTANOIC ACID AS A RADIOPROTECTIVE FOR A STRAIN OF MOUSE. R. Goutier and M. L. Beaumariage (Universite, Liège). Arch. intern. pharmacodynamie, 126: 341-5(1960). (In French)

6-8 Dithioctanoic acid is toxic for the black C_{57} strain mouse. Injected intraperitoneally 20 min before whole-body x irradiation of 700 r, 6-8 dithioctanoic acid shows no radioprotective effect. (auth)

11490 AN ANTIPROTEOLYTIC FACTOR IN BLOOD PLASMA AND ITS VARIATION IN RESPONSE TO RADIATION INJURY IN ANIMALS. R. G. Mkrtchyan and B. N. Tarusov (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 142: 462-4(Jan. 11, 1962). (In Russian)

An attempt is made to detect a blood factor which can interrupt or suppress proteolytic reactions in the organs of irradiated animals. White rats were given a gamma-ray dose of 800 r, the animals were killed on the seventh day after irradiation, and homogenized samples of the liver were prepared. Liver suspensions were made up in distilled water (series I, control), in the blood plasma of intact rabbits (series II), and in the blood plasma taken from rabbits at various intervals of time after being given a dose of 800 r of gamma rays. Controls in distilled water were run on series II and III. The amount of amino nitrogen, determined colorimetrically after incubation of the sample at 36°C for 6 hours, was taken as a measure of proteolytic activity. Intact rats showed 83 mg-% of amino nitrogen in the distilled water suspension with an increase to 325 mg-% after 6 hours incubation. The amount of amino nitrogen was 215 mg-% after 6 hours incubation on preparing the liver suspension in blood plasma. After irradiation the amounts of amino nitrogen in distilled water were 142 mg-% initially and 650 mg-% after 6 hours incubation, an increase of 100% over the controls. However, on suspending the irradiated homogenized liver in the blood plasma of intact rabbits (series II), the final amount of amino nitrogen was about the same as that for the control. The intact plasma has an antiproteolytic effect. On suspending the irradiated homogenized liver in the blood plasma of irradiated rabbits, there was a sharp increase in proteolytic activity. The antiproteolytic factor is re-established in the blood plasma of irradiated rabbits about 20 to 25 days after the irradiation. The antiproteolytic factor is destroyed by heating at 60°C for 15 minutes, but is stable for at least 14 days, when the blood plasma is stored at 4°C. (TTT)

11491 CONTRIBUTION TO THE STUDY OF LETHAL AND CANCEROUS EFFECTS OF RADIOCOBALT. EFFECT OF CHEMICAL PROTECTION. D. J. Méwissen. J. belge radiol., 44: 548-50(1961). (In French)

In order to help clarify the complexity of the phenomena of cellular radiolesions together with the complexity of the problems of chemical protection against these lesions, mice of pure C57 BL were exposed to whole-body irradiation with cobalt. Part of the mice received cysteamine or cystamine in various ways. A chronological study was made of the effects of the chemical protectors on the early and late effects of radiation. (J.S.R.)

11492 HOMOTRANSPLANTATION OF SKIN AND FETAL HEMATOPOIETIC TISSUE IN LETHALLY IRRADIATED MICE. Michio Matsukura, Morimasa Sekiguchi, and Yukio Ishibashi (Tokyo Univ.). Japan J. Exptl. Med., 31: 301-5(Aug. 1961). (In English)

Skin homotransplantations were performed in the mice that were restored by the administration of homologous fetal hematopoietic tissues after lethal whole-body irradiation. Three different strains of inbred mice were used for recipients, donors of skin homografts, and donors of fetal hematopoietic tissues. The prolongation of the survival times of the skin homografts was observed until 60 days, in maximum, after the transplantation. The mechanism of the prolongation and a hypothesis of tolerance are discussed on the basis of the principles of both actively acquired tolerance and radiation chimera. (auth)

11493 A COMPARATIVE ASSESSMENT OF THE ACTION OF EMULSION FROM THE JUICE OF ALOE ARBORESCENS AND ALOE-STRIATULA FOR THE PREVENTION OF RADIUM INJURIES. N. P. Mordvinova and B. K. Rostotskii (State Scientific-Research Inst. of Roentgen-Radiology, Ministry of Public Health, USSR and All-Union Scientific Research Inst. of Medicinal and Arometic Plants, USSR). Med. Radiol., 6: No. 11, 16-20 (Nov. 1961). (In Russian)

An emulsion was prepared from the juice of aloe-Striatula. The action of the emulsion was checked in 60 patients who subjected to telegammatherapy for malignant tumors. Upon daily treatment of the skin with the emulsion, the dose could be increased from 500 to 1200 r per skin field, simultaneously decreasing the degree of skin reaction. The emulsion accelerates the process of epithelization in moist epidermitis and is endowed with the same positive properties as emulsion from Aloe arborescens. (auth)

11494 THE USE OF ACTH DURING THE ACTION OF IONIZING RADIATION ON THE ORGANISM IN CLINICAL AND EXPERIMENTAL CONDITIONS. M. Ya. Chaikovskaya, M. P. Eleazarova, V. B. Zairat'yants, N. I. Karlashenko, and E. G. Parfenova (State Scientific-Research Roentgen-Radiological Inst., Ministry of Public Health, USSR). Med. Radiol., 6: No. 11, 20-6(Nov. 1961). (In Russian)

Studies were made of the therapeutic action of ACTH in radiation injuries and in complications occurring in patients due to radiotherapy. The investigations show that ACTH may successfully be employed in a complex with other measures in the treatment of radiation complications (pneumosclerosis, radiation ulcers), as well as for the alleviation of manifestations of general radiation reactions in patients during telegammatherapy of malignant neoformations. In experiments staged on 30 dogs and 300 albino rats subjected to irradiation (LD50) optimum ACTH dosages and administration times were determined. (auth)

11495 ON THE REACTIVITY OF THE ORGANISM TO MEDICINAL SUBSTANCES IN RADIATION SICKNESS. V. E. Belai, P. V. Vasil'ev, P. P. Saksonov, and G. T. Chernenko. Med. Radiol., 6: No. 11, 72-8(Nov. 1961). (In Russian)

A review is given of published data on the reactivity of organisms to pharmaceutical substances during radiation sickness. The reactions of the injured organisms to narcotic, analgesic substances, and nervous system and blood-forming stimulants were analyzed, as well as chemotheropeutic preparations and diuretic substances. The materials indicate that the effects of pharmachological therapy depends on the degree of radiation injury and the period of its development. (R.V.J.)

11496 THE PREVENTION AND TREATMENT OF RADIATION SICKNESS OF GRAVID ANIMALS AND THEIR FETUSES BY MEANS OF CYSTAMINE AND BATYL ALCOHOL. V. N. Dudin. Med. Radiol., 6: No. 11, 82-4 (Nov. 1961). (In Russian)

Data are given on separate and combined applications of prophylactic (cystamine) and therapeutic (batyl alcohol) preparations as protective measures for mothers and embryos against radiation injuries. The tabulated data on survival and development of rat progenies born to mothers irradiated with a dose of 300 r on the 15th day of pregnancy show the treatments produced a favorable effect, and reducing still births (23.99%) and post-natal mortality (23%). Treatment with combined cystamine and batyl alcohol not only considerably reduced the mortality of the progenies, but also prevented anemia and leukopenia. (R.V.J.)

11497 DYNAMICS OF ARTERIAL PRESSURE IN WHOLE-BODY IRRADIATION OF RATS. I. S. Kanfor. Med. Radiol., 7: No. 1, 70-2 (Jan. 1962). (In Russian)

Systolic arterial pressure and vessel constriction and expansion are important indices of radiation injuries. Systolic arterial pressures not exceeding 50 to 60 mm mercury along with other data indicate a favorable outcome of the sickness. (R.V.J.)

11498 PATHOGENESIS OF RADIATION HEMORRHAGE. M. O. Raushenbakh (Central Order of Lenin Inst. of Hematology and Blood Transfusion, USSR). Med. Radiol., 7: No. 1, 83-7 (Jan. 1962). (In Russian)

An analysis is given of the genesis of radiation hemorrhage. Differences in the intensity and appearance of hemorrhagic syndrome were studied in dogs, monkeys, and smaller animals (guinea pigs, rats, and mice). Alterations in vessel penetrability, blood coagulation, and serotonin metabolism were investigated, and the results stress the disturbances of trombocyteric factors and serotonic metabolism. (R.V.J.)

11499 INVESTIGATION OF A MICROBIOLOGICAL TESTING OF THE RADIATION PROTECTIVE EFFECT OF SULFHYDRYL COMPOUNDS. Armin von Szilvinyi, Helga Manschinger, Agnes Rath, and Uta Rosenkranz (Hochschule für Bodenkultur, Vienna). Naturwissenschaften, 48: 742 (1961). (In German)

A microbiological method for evaluating the radiation protective effect of sulfhydryl compounds is given. A culture containing only germinating cells was exposed to 12000 rad of β radiation 12 hrs after the addition of sulfhydryl compounds to the culture. Direct microscopic readings were made on the culture surface. The effective concentration and the protective effect were determined for 15 compounds, and the results are tabulated. The position correlation of the compounds between the microbiological method and the animal research method were established. (J.S.R.)

11500 EFFECTS OF ORALLY ADMINISTERED CYSTAMINE ON THE VARIATIONS OF THE WEIGHT OF ORGANS OF C57 BL MICE TREATED WITH RADIOACTIVE GOLD. D. J. Mewissen and E. P. Malaise (Universite, Liège). Radiobiol. Latina, 4: 1-10 (Jan.-Mar. 1961). (In Italian)

Observations on the variations in the weights of the liver, spleen, and kidneys after injection of radioactive colloidal gold may be summarized as follows. A beneficial effect of cysteamine on the regeneration of these organs was shown, but only after intraperitoneal injection. The efficiency of oral cysteamine appeared to depend on the total dose of radiation and the dose rate. This explains the insignificant effect with doses greater than LD 50/30 days. (auth)

CHEMISTRY

General and Miscellaneous

11501 (ANL-6413) CHEMICAL ENGINEERING DIVISION SUMMARY REPORT, JULY, AUGUST, SEPTEMBER, 1961. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 216p.

Development activities are reported on pyrometallurgical processes including melt refining and those using liquid metal solvents. Development of processing facilities for EBR II is also reported. In other work, laboratory- and engineering-scale investigations on fluoride volatility processes were conducted, and conversion of UF_6 to UO_2 was studied. Investigations are also reported concerning the kinetics of metal ignition and oxidation, and metal-water reactions. In work associated with reactor chemistry, data on nuclear constants are reported and developments in thermoelectricity and reactor decontamination are described. (J.R.D.)

11502 (MLM-1119) MOUND LABORATORY MONTHLY PROGRESS REPORT [ON CHEMISTRY] FOR SEPTEMBER 1961. J. F. Eichelberger (Mound Lab., Miamisburg, Ohio). Sept. 29, 1961. Contract AT-33-1-GEN-53. 15p.

Process development for separation and purification of xenon, carbon, hydrogen, and helium isotopes are reported. Krypton sample preparation is also reported. Analytical methods were developed for Be in air, half-life of Ce^{141}, and calorimetric half-life measurements of Ra^{223}. In other work, development of techniques for casting films on glass, plastic, and water is reported. High-temperature properties of Ce–Co–Pu alloys were measured, and a high-temperature calorimeter was developed. Phase studies of gold–plutonium alloys were conducted and preparation of Pu-bearing glass is reported. (J.R.D.)

11503 (ORNL-TM-34) CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, JUNE 1961. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Jan. 23, 1962. Contract [W-7405-Eng-26]. 68p.

An interfacial viscometer was built for use in an interfacial phenomena study. Installation of a 6-in.-ID foam separation column system was completed. The dispersion-drying-sintering characteristics of six low-nitrate batches of thoria sol material were studied. The average effective porosity of the CuO pellets used for reactor helium purification was determined to be 0.0545 for H_2 transport and 0.0526 for CO transport. In continuous Zirflex dissolution studies, no H_2O_2 decomposition was observed when 10% H_2O_2 was fed into boiling dissolvent through a water-cooled nozzle and the oxygen concentration in the scrubbed off-gas could be used to control the H_2O_2 concentration in the dissolver. The free fluoride in Zirflex solutions must be maintained above 1 molar in order to prevent uranium precipitation at low concentrations of uranium even though the F^-/U ratio exceeds 100. Chopped stainless steel-clad UO_2 sections were leached in a 4 stage pyrex leacher model using 6, 7, and 8 M nitric acid as the dissolvent. The temperature distribution expected within fuel elements consisting of square arrays of tubes was calculated for shipping conditions assuming heat to be transferred only by radiation. HETS values were calculated for uranium stripping under 5% TBP flowsheet conditions. Very fine particles were obtained by quenching fused salt droplets in water. A waste calcination run was made using TBP-25 waste and the close coupled evaporator-calciner system. (auth)

11504 (NP-tr-837) PRINCIPLES AND APPLICATIONS OF DYNAMICAL DIFFERENTIAL CALORIMETRY. H. E. Schwiete and G. Ziegler. Translated by F. Hudswell (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Ber. deut. keram. Ges., 35: 193-204(1958). 48p.

Dynamical differential calorimetry (DDK), unlike differential thermal analysis (DTA), makes it possible quantitatively to evaluate thermal effects. The difference of DDK from DTA lies in the fact that the measurement of the temperature is made, not at the center of the sample, but at metallic auxiliary substances through which the total heat consumed in the sample has to be conducted. With the aid of thermodynamical considerations, it is possible to derive expressions for the calibration of the apparatus. The heats of fusion and transition of lithium sulfate and the heat of fusion and behavior on heating of sodium disilicate were determined by DDK. The application of DDK to silicate technology and research is discussed in detail. (D.L.C.)

Analytical Procedures

Refer also to abstracts 11957, 12667, and 12668

11505 (AERE-AM-86) THE DETERMINATION OF SULPHUR IN BERYLLIUM OXIDE. R. G. Richards (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Chatham Outstation, Kent, England). Dec. 1961. 9p.

The sample is dissolved in a titanium-phosphoric acid reagent, which reduced sulfate to sulfide. The H_2S thus formed is swept away in a current of N_2 into a zinc acetate solution. By reaction with p-phenylene-diamine and ferric chloride the sulfide is converted to Lauth's violet, which is determined absorptiometrically. The method is suitable for sulfate concentrations of 20 to 400 ppm, and the error should not exceed ± 10%. (auth)

11506 (AERE-AM-87) THE DETERMINATION OF RADIOANTIMONY. J. W. Arden, G. J. Hunter, and M. Perkins (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Jan. 1962. 15p.

Exchange is established between radioantimony and Sb carrier in a dilute sulfuric acid solution containing Sn carrier and Br. Sb and Sn are then recovered as the sulfides. Antimony sulfide is then precipitated alone from a solution containing HF, which prevents the precipitation of tin sulfide. Te nuclides are removed by the precipitation of Te metal with SO_2. The Sb is then extracted from 2M HCl into iso-amyl alcohol containing 1% diphenyl-carbazone, and counted. The method is designed for Sb^{125} determination in solutions of irradiated U. It is assumed that all shorter-lived nuclides are present only in negligible concentrations, an assumption that is valid after a 3-month cooling period. The coefficient of variation should not exceed 2% under favorable counting statistics. (auth)

11507 (AERE-AM-88) THE DETERMINATION OF RADIOMOLYBDENUM. J. W. Arden, G. J. Hunter, and M. Perkins (United Kingdom Atomic Energy Authority.

Research Group. Chemistry Div., Woolwich Outstation, England). Jan. 1962. 12p.

Exchange is established between radiomolybdenum and Mo carrier in a solution containing iodine carrier and potassium permanganate. After scavenging with ferric hydroxide, the Mo is extracted as the α-benzoinoxime complex into ethyl acetate, with subsequent stripping into dilute ammonia solution. After repeating the extraction procedure, the Mo is finally precipitated as lead molybdate, which is counted. The method is applicable to solutions of fission products in nitric or hydrochloric acid, and finds particular application in the determination of Mo^{99}. The coefficient of variation should not exceed 2% under favorable counting statistics. (auth)

11508 (AERE-R-3838) NON-DESTRUCTIVE DETERMINATION OF PLUTONIUM-239 IN CERAMIC FUEL ELEMENT PELLETS BY GAMMA SPECTROMETRY. A. J. Fudge, G. Phillips, and E. Foster (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1962. 22p.

An investigation of the gamma spectrum of pure Pu^{239} showed that the most energetic gamma ray at 384 kev enabled a technique to be established for its non-destructive analysis. This technique was applied to ceramic fuel element pellets containing PuO_2 in the concentration range $\geq 0.2\%$ PuO_2 (by weight) in MgO and $\geq 1\%$ PuO_2 (by weight) in natural UO_2. Batches of fuel element pellets were examined for reproducibility of PuO_2 content by gamma spectrometry, calibration of the instrument being obtained by using chemically analyzed pellets selected at random from each batch. Preliminary work was carried out on a manually operated gamma spectrometer using a $1\frac{3}{4}$ in. by 2 in. NaI crystal. Based upon experience with this equipment a prototype automatic gamma spectrometer was developed. This was designed to enable large numbers of alpha active ceramic pellets to be gamma counted without the necessity of an individual container for each pellet. The best precision obtained with this equipment indicated that a batch of seven 10% PuO_2 in UO_2 pellets were identical in composition within a coefficient of variation of 0.3%. This conclusion was confirmed by a precise chemical analysis. The precision obtainable is limited either by counting statistics on the one hand or electronic stability on the other. (auth)

11509 (CISE-90) TECNICHE, APPARECCHIATURE E DATI SPERIMENTALI PER L'ANALISI CHIMICA E RADIOCHIMICA. 8-SEPARAZIONE DI ELEMENTI, METODI ANALITICI E LORO RECENTI SVILUPPI. (Techniques, Apparatus and Experimental Data for Chemical and Radiochemical Analysis. 8-Separation of Elements, Analytical Methods and Their New Developments). C. Testa (Centro Informazioni Studi Esperienze, Milan). Sept. 1961. 118p.

A detailed description is presented of the more important methods used in the Analytical Chemistry Laboratory of CISE for the separation and analysis of chemical elements. Special considerations are given for the elements of interest to the nuclear field. (tr-auth)

11510 (CRDC-1051) HEAVY WATER ANALYSIS IN THE 1% TO 99% D_2O RANGE BY INFRARED SPECTROPHOTOMETRY. W. H. Stevens, J. G. Bayly, W. Thurston, and V. B. Kartha (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 32p. (AECL-1391)

Two infrared methods have been developed for analysis of heavy water in the 1 to 99% D_2O concentration range. A Perkin-Elmer Model 21 double-beam spectrophotometer was used with the addition of a variable neutral attenuating filter in the reference beam. One method is based on measurement of optical densities at transmission peaks, at about 2700 and 1900 cm^{-1}. These peaks result from the overlapping of several absorption bands in the $H_2O-HDO-D_2O$ system. The method is empirical. With a 0.25 mm sample thickness the standard deviation is 0.01% at 99% D_2O, 0.1% at 40% D_2O, and 0.01% at 1% D_2O. The second method is based on measurement of optical densities at 1645, 1460, and 1220 cm^{-1}, the ν_2 normal vibrations of H_2O, HDO, and D_2O, respectively. Composition of a sample can be calculated from these optical densities since extinction coefficients have been determined, and Beer's Law shown to hold, for each component at these wavenumbers. In practice, the composition can be determined from the ratios of the transmittances at these wavenumbers by means of a nomograph. With a 0.025 mm sample thickness the standard deviation is <0.15% D_2O over the 1 to 99% D_2O concentration range. (auth)

11511 (CRDC-1059) POLAROGRAPHIC DETERMINATION OF SOME METAL IONS BY MEANS OF THEIR ETHYLENEDIAMINE TARTRATE COMPLEXES. Thomas Bruce and Robert W. Ashley (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1961. 12p. (AECL-1409)

The elements Fe, Ni, Cd, Cu, Zn, and Co form complexes in ethylenediamine tartrate solution. These complexes are reduced at the dropping mercury electrode with well defined waves, without maxima. Polarographic media were studied including a solution 0.5M in sodium ethylenediamine tartrate, and 0.1M in sodium pyrophosphate, a solution of 0.5M in ammonium ethylenediamine tartrate and 0.1M in ammonium chloride, and a solution of 0.5M in sodium ethylenediamine tartrate and 0.1M in sodium chloride. Cd and Cu showed reduction waves in all three media. Ferrous iron was reduced only in the $NaEDT-Na_4P_2O_7$ and NaEDT-NaCl solutions. Ni and Zn were not reduced in the solution containing $Na_4P_2O_7$ but showed waves in the other two solutions. Co gave a reduction wave only in the $NH_4EDT-NH_4Cl$ solution. Procedures were developed for four of these metals, singly in solution, and for Ni, Cd, and Cu together in the same solution. It is suggested that ehtylenediamine tartrate complexes may be useful for the polarographic determination of a number of other metallic ions. (auth)

11512 (CRDC-1070) THRESHOLD REACTION INTERFERENCE IN NEUTRON ACTIVATION ANALYSIS. R. W. Durham, M. P. Navalkar, and E. Ricci (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1962. 19p. (AECL-1434)

Presented at the 1961 International Conference on Activation Analysis, A. and M. College of Texas, December 15-16, 1961.

The high energy (>0.5 Mev) component of a reactor flux can produce, via threshold reactions on the major constituents of a sample, identical activities as those produced by the thermal flux, through (n,γ) reactions, on the impurities being determined. In order to predict these interferences in thermal neutron activation analysis, it is necessary to know the cross section of the threshold reaction in a pure fission neutron flux and the fraction of the reactor thermal flux, nv_θ, above about 0.5 Mev which has the properties of a pure fission flux. The latter was determined in an empty fuel rod position in the NRX reactor using the reaction U-238 (n,f) as a monitor. Based on this value, fission neutron cross sections were measured for several (n,p), (n,α), (n,2n), and (n,n') reactions. The interferences caused by the (n,p) and (n,α) reactions in this particular irradiation position are given. An example of activation by (n,2n) and (n,n') reactions, when the (n,γ) reaction is not suitable, is also discussed. (auth)

11513 (NP-11579) METHODS FOR EASY DETERMINATION OF PHOSPHORUS-32 (P^{32}) IN PLANTS. E. C. S. Little (International Atomic Energy Agency, Vienna). [1962]. 14p. (SM-23/27)

For presentation at Symposium on the Use of Radioisotopes in Soil-Plant Nutrition Studies, February 26–March 2, 1962, Bombay.

Procedures are described for the quantitative radioautographic determination of P^{32} in samples of agricultural materials. Calibrated samples are exposed simultaneously, thus eliminating problems of decay. Data from preliminary measurements of P^{32} in plant material are included. (C.H.)

11514 (ORO-483) INVESTIGATION OF A RADIOACTIVITY TECHNIQUE FOR THE DETERMINATION OF DISSOLVED OXYGEN. Final Report. Arthur S. Gillespie, Jr. (Research Triangle Inst. Durham, N. C. Isotope Development Lab.). Oct. 23, 1961. Contract AT(40-1)-2513. 20p. (RTI-2513-T6-1)

A technique for determining the dissolved oxygen concentration of both pure and natural waters has been developed. It is based on the quantitative oxidation of thallium metal containing Tl^{204} by aqueous dissolved oxygen. The analyzer consists of a column of thallium–Tl^{204} metal, deposited on copper turnings, below which is a flow-type Geiger-Mueller tube. Water containing the dissolved oxygen is passed through the Tl–Tl^{204} column whereupon Tl^{+} ions are formed. The Tl^{204}, released at the same time, is detected in the G-M tube and the counting rate is a direct measure of the dissolved oxygen concentration. In pure water the Tl^{204} counting rate is linear with dissolved oxygen concentration down to the lowest concentration investigated, 0.2 ppm. In sea water and salt water, the Tl^{204} counting rate is not linear with dissolved oxygen concentration above about 3 ppm and a calibration curve must be used. Linearity in sea water could be achieved by depositing the thallium on a metal more inert than copper. The effects of pH, buffers, and various oxidizing agents were also studied. Using the highest specific activity Tl^{204} available, it should be possible to determine dissolved oxygen to 1 part in 10^{12}. (auth)

11515 (PG-Report-59) ANALYTICAL METHOD FOR THE SPECTROGRAPHIC DETERMINATION OF SODIUM IN URANIUM TETRAFLUORIDE. (United Kingdom Atomic Energy Authority. Production Group. Springfields, Lancs, England). 1962. 11p.

The sample is converted to uranyl nitrate hexahydrate and dissolved in water. The solution is then examined by the Lundegardh flame technique and the spectrograms are evaluated microphotometrically. The method is suitable for samples containing from 20 to 10,000 ppm of sodium with a precision of ±10%. (auth)

11516 (PG-Report-247) ANALYTICAL METHOD FOR THE DETERMINATION OF WATER IN URANIUM TETRAFLUORIDE AND URANIUM DIOXIDE (KARL FISCHER METHOD). (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 4p.

In this method, a portion of the ground sample is suspended in methanol and titrated directly with Fischer Reagent to an electrometric end point. The method is applicable to a concentration range 0.02 to 1.0 wt % H_2O but not to material produced by a fluidized bed process. (D.L.C.)

11517 (PG-Report-266) ANALYTICAL METHOD FOR THE DETERMINATION OF BERYLLIUM, TITANIUM AND MANGANESE IN BERYL ORE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 11p.

The analytical method involves fusing the sample with potassium hydrogen fluoride which is then sulfated. The melt is dissolved in dilute HCl. Beryllium is determined in the solution gravimetrically as pyrophosphate, titanium absorptiometrically with H_2O_2 and manganese volumetrically after oxidation to permanganate. (J.R.D.)

11518 (PG-Report-289) ANALYTICAL METHODS FOR THE INSPECTION OF SULFURIC ACID SOLUTIONS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 8p.

The inspection method includes titrimetric acid assay, turbidimetric chloride determination, absorptiometric iron determination, and gravimetric residue determination. (J.R.D.)

11519 (PG-Report-309) ANALYTICAL METHOD FOR THE TITRIMETRIC DETERMINATION OF PLUTONIUM (CHROMOUS REDUCTION–CERIC SULPHATE TITRATION). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 5p.

Following the removal of nitric acid, Pu is reduced to the trivalent state with an excess of chromous chloride. The excess of chromous salt is oxidized with air, and the Pu is titrated to the tetravalent form with standard ceric sulfate. The titration end point is obtained potentiometrically. The method has a bias of about +0.7%. The precision (3 × sigma) is ±1.23%. The method may be used for determinations of 20 to 50 mg of Pu in any volume of sample taken. If Fe is present a correction must be applied to the result. (auth)

11520 (PG-Report-310) ANALYTICAL METHOD FOR THE DETERMINATION OF CHROMATE IN COOLING WATER. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 3p.

The intensity of the yellow color caused by the presence of chromate ion in water is measured by absorptiometry. The method is designed to determine chromate ion in cooling waters using the phosphate delayed chromate method of corrosion treatment in the pH range 7.8 to 8.9. (auth)

11521 (TID-15046) THE DETERMINATION OF ZINC, COPPER AND IRON IN BIOLOGICAL TISSUES–AN X-RAY FLUORESCENCE METHOD. George V. Alexander (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). [Jan. 25, 1962]. Contract AT(04-1)-GEN-12. 17p.

A x-ray fluorescence method for the determination of zinc, copper, and iron in biological tissue ash was developed. The method has adequate sensitivity for the determination of zinc in all biological tissues and was found to be independent of matrix variations. Details of the method and an example of its use for the determination of zinc in plasma are presented. (auth)

11522 (TID-15082) DEVELOPMENT OF KRYPTON-85 CLATHRATE ANALYTICAL TECHNIQUES TO MEASURE OXIDATION-REDUCTION PRODUCTS IN THE LIQUID STATE. Quarterly Technical Status Report No. 1, June 15, 1961 to September 29, 1961. George J. Rotariu, Donald M. Hattori, and Elizabeth L. Hoskins (Booz-Allen Applied Research, Inc., Glenview, Ill.). Oct. 20, 1961. Contract AT(11-1)-1061. 50p.

Preparation of hydroquinone : SO_2 clathrate by an improved method and recording its infrared spectrum at 2 to 25 microns are reported. A novel "chain reaction" concept was formulated for the determination of substances which can clathrate with hydroquinone. This could provide the highest chemical amplification and sensitivity of measurement to data. Tests showed that solid hydroquinone :

SO_2 is most stable in FC-43 fluorocarbon and trifluorotoluene. The best system found to date for determination of aqueous ferric ion via the proposed clathrate scheme is by extraction of ferric ion with TTA dissolved in trifluorotoluene. The HQ:SO_2 clathrate is least decomposed in the trifluorotoluene. An initial test for reaction between ferric ion-TTA with solid HQ:SO_2 all in trifluorotoluene gave indication of a slight reaction. It was found that ferric chloride dissolved in benzene, toluene, xylene, nitrile silicone, FC-43 fluorocarbon, and trifluorotoluene reacts directly with suspended solid HQ:SO_2 clathrate. The reaction is slow at room temperature and more rapid at elevated temperatures. Ferric nitrate under the same conditions reacts faster than the chloride with the clathrate. (auth)

11523 (TID-15106) COULOMETRIC ANALYSIS OF RARE-EARTH ELEMENTS AT CONTROLLED POTENTIAL. Progress Report, February 20, 1961–February 20, 1962. Edward N. Wise (Arizona. Univ., Tucson). Feb. 23, 1962. Contract AT(11-1)-553. 7p.

The polarographic investigation of Sa and Nd is reported by use of an acetonitrile solvent containing tetraethylammonium perchlorate ($TEACl_4$). The results on polarographic reduction of these elements are sufficiently encouraging to warrant continuation of the study by further coulometric work. If these studies are successful, consideration will be given to the use of acetonitrile-$TEACl_4$ system for reduction of thulium. In other work, development of a precise wide-range direct-reading coulometer is reported for current-flow integration during controlled-potential electrolysis. Initiation of a study on the design of a time-sequence sampling differential polarograph is also reported. (J.R.D.)

11524 (UCRL-6639) SOME RECENTLY DEVELOPED CHEMICAL AND PHYSICAL ANALYTICAL METHODS. R. G. Gutmacher, J. E. Harrar, and R. K. Pearson, comps. and eds. (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 30, 1961. Contract W-7405-Eng-48. 41p.

Seven papers are included which treat analysis of beryllium oxide, determination of compounds occurring in explosives, preparation of BF_3 for boron isotope ratio determinations, and density measurement for solids. Separate abstracts were prepared for all the papers. (D.L.C.)

11525 (UCRL-6639(p.1-9)) [PART] I. THE DETERMINATION OF URANIUM IN BERYLLIUM OXIDE–URANIUM OXIDE MIXTURES. Walter G. Boyle (California. Univ., Livermore. Lawrence Radiation Lab.).

A procedure for dissolving BeO–UO_2 ceramic pieces is described which uses $HClO_4$–H_2SO_4 as solvent. Two titration methods are outlined for determining uranium in dissolved BeO–UO_2, one for precise standardization and research-type samples and the other for routine samples. Both methods use preliminary reduction of uranium by chromous ions; the more exact method uses potassium dichromate as the titrant with 1,5-dimethyl ferroin as indicator, while ceric sulfate titrant and ferroin indicator are used for automatic titration in the routine method. (D.L.C.)

11526 (UCRL-6639(p.10-15)) [PART] II. DETERMINATION OF MILLIGRAM AMOUNTS OF SULFATE IN BERYLLIUM OXIDE. Robert Lim (California. Univ., Livermore. Lawrence Radiation Lab.).

An acid-washed alumina column is used to separate sulfate ions from large amounts of Be, ClO_4^-, Cl^-, and NO_3^-. The sulfate is removed from the column with NH_4OH, converted to H_2SO_4 by cation exchange, and precipitated with $BaCl_2$ solution. The excess $BaCl_2$ is back-titrated with EDTA using Eriochrome Black-T as indicator. The sensitivity of the method is 0.05 mg sulfate. (D.L.C.)

11527 (UCRL-6639(p.16-19)) [PART] III. SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN BERYLLIUM OXIDE POWDER, HIGH-FIRED BERYLLIUM OXIDE, AND HIGH-FIRED BERYLLIUM OXIDE–URANIUM OXIDE. William F. Morris (California. Univ., Livermore. Lawrence Radiation Lab.).

A spectrographic method for determination of impurities in beryllium oxide was developed which employs the d-c arc discharge for exciting the sample. Volatilization of the impurity elements into the arc column is achieved by carrier distillation or by complete burn. Spectrographic conditions are given. The precision of the method is ±30 to 50% at levels <50 ppm (visual determination of spectrum line intensity) and ±10% at levels >50 ppm (densitometric determination). (D.L.C.)

11528 (UCRL-6639(p.20-8)) [PART] IV. MICRODETERMINATION OF AROMATIC NITRO COMPOUNDS, NITROCELLULOSE, AND CYCLIC NITRAMINES. Walter Selig (California. Univ., Livermore. Lawrence Radiation Lab.).

Jamison's method, using $CrCl_2$ to reduce nitro groups in organic compounds, was modified for use with water-insoluble nitro compounds on a micro scale. A sample of 5 mg is dissolved in glacial acetic acid or dimethylformamide, HCl is added to a normality of 2.6 N, the nitro groups are reduced with 250% excess $CrCl_2$ at room temperature, and the unreacted Cr^{2+} is titrated with Fe^{3+} using phenosafranin to detect the end point. The method was further modified for sym-cyclotetramethylenetetranitramine by using a sample size of 2.5 mg, adding HCl to 3.8 N, and carrying out the reduction at 70°C with an excess of 500% $CrCl_2$. The results are accurate to ±0.5% NO_2. (D.L.C.)

11529 (UCRL-6639(p.29-32)) [PART] V. DETERMINATION OF Kel–F AND/OR TEFLON IN PLASTIC BONDED EXPLOSIVES. Walter Selig and David M. Colman (California. Univ., Livermore. Lawrence Radiation Lab.).

A rapid method for determining Teflon and Kel-F in plastic-bonded explosives was developed which may be used in the case where both Teflon and Kel-F are present in the sample. A 5- to 10-mg sample is put into solution by combustion, and the fluorine and chlorine are respectively determined by thorium nitrate-Alizarin red S and mercuric perchlorate-diphenyl carbazide titrations. The time for a single analysis is 1 to 1.5 hr. (D.L.C.)

11530 (UCRL-6639(p.33-5)) [PART] VI. PREPARATION OF BORON TRIFLUORIDE FOR ISOTOPE RATIO DETERMINATION. R. W. Crawford and R. K. Pearson (California. Univ., Livermore. Lawrence Radiation Lab.).

A method is given for converting elemental boron or a boron polymer mixed in a plastic to gaseous BF_3 for mass spectrographic determination of the boron isotope ratio. The plastic sample is ignited and treated with concentrated HNO_3 to convert the boron into H_3BO_3. The H_3BO_3 residue is treated with CaF_2 powder and concentrated H_2SO_4 to liberate BF_3 gas. (D.L.C.)

11531 (UCRL-6639(p.36-41)) [PART] VII. A HELIUM DENSITOMETER. Richard K. Pearson (California. Univ., Livermore. Lawrence Radiation Lab.).

A helium densitometer for determination of densities of powdered materials is described. The precision and accuracy were within ±0.3%. (auth)

11532 (UR-606) THE SEPARATION AND DETERMINATION OF PLUTONIUM IN DIVERSE BIOLOGICAL

SAMPLES. Taft Y. Toribara, Carol Predmore, and Paul A. Hargrave (Rochester, N. Y. Univ. Atomic Energy Project). Jan. 22, 1962. Contract W-7401-Eng-49. 12p.

A simplified separation scheme for plutonium in biological samples was devised. It is based on the absorption of an anionic form of tetravalent plutonium in a strong hydrochloric acid solution by a strong base anion exchange resin. The greatest difficulty in obtaining complete recovery from some samples was in getting the sample completely dissolved. For the acid insoluble portion of samples such as fecal ash it was necessary to resort to carbonate and bisulfate fusions. Elution from the ion exchange column was accomplished with sulfurous acid, and the final estimation was made by liquid scintillation counting. (auth)

11533 (UR-607) LIQUID SCINTILLATION COUNTING OF PLUTONIUM-239 FROM BIOLOGICAL SAMPLES. Taft Y. Toribara, Donald A. Morken, and Carol Predmore (Rochester, N. Y. Univ. Atomic Energy Project). Jan. 23, 1962. Contract W-7401-Eng-49. 10p.

The conditions for the measurement of Pu^{239} activity from biological samples by liquid scintillation counting were determined. It was found that considerable quantities of iron may be tolerated in the final counting solution if phosphoric acid is added to form a colorless complex. Appreciable quantities of plutonium were adsorbed on the counting bottle when perchloric acid was used, and again the addition of phosphoric acid eliminated the difficulty by complexing the plutonium. (auth)

11534 (AEC-tr-5043) TECHNIQUES AND APPLICATIONS OF GASEOUS PHASE RADIOCHROMATOGRAPHY. Jean-Pierre Adloff. Translated by M. S. Feldman (Savannah River Lab., Aiken, S. C.) from J. Chromatog., 6: 373-80(Nov. 1961). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 4147.

11535 VOLUMETRIC ASSAY METHOD FOR PLUTONIUM USING SPECTROPHOTOMETRIC END POINT DETECTION. C. E. Caldwell, L. F. Grill, R. G. Kurtz, F. J. Miner, and N. E. Moody (Dow Chemical Co., Denver). Anal. Chem., 34: 346-8(Mar. 1962). (RFP-234)

A titrimetric method for the assay of plutonium metal permits used of large samples and involves a spectrophotometric determination of the end point. The standard deviation as measured by assaying a number of aliquants of the same metal sample is ±0.07%. The same precision was obtained on a series of separate metal samples that were assayed, then resubmitted. Only iron was present in the samples investigated in sufficient concentration to interfere. The iron reaction was stoichiometric, so a correction was applied after determining the iron in a separate aliquot of the plutonium. (auth)

11536 SEPARATION OF STRONTIUM-90 AND YTTRIUM-90 WITH ION EXCHANGE PAPERS. Patricia C. Stein (Los Alamos Scientific Lab., N. Mex.). Anal. Chem., 34: 352-4(Mar. 1962).

A method of separating strontium-90 from yttrium-90 using ion exchange impregnated papers is described. Three successful separations were made employing an Amberlite IR-120 paper with a citrate eluent adjusted to pH 3.8, an IR-4B resin paper with H_2O as the eluent, and a cellulose phosphate impregnated paper with 5N HCl as eluent. The use of these papers has numerous advantages in ease and safety of handling, the short time necessary for the separation, and the adaptability to a radiometric study of the results. (auth)

11537 IRON(II) AS AN INDICATOR ION FOR AMPEROMETRIC TITRATIONS WITH (ETHYLENEDINITRILO) TETRAACETIC ACID. APPLICATION TO THE DETERMINATION OF THORIUM. Gerald Goldstein, D. L. Manning, and H. E. Zittel (Oak Ridge National Lab., Tenn.). Anal. Chem., 34: 358-61(Mar. 1962).

A method for amperometric titrations with EDTA in which Fe^{2+} is used as an indicator is described. A potential of +0.4 volt vs the S.C.E. is applied to a platinum electrode. At this potential Fe^{2+} is not oxidized; however, FeY^{2-}, which is formed after the titration is complete, is oxidized, and the excess titrant is indicated by a linear increase in current. Most titrations are carried out in an acetate buffered medium at pH 4.5. This method is applicable to the determination of elements that form EDTA chelates with a stability constant of 10^{17} or greater with several exceptions. Thorium(IV) in the presence of U^{6+}, Zr, and other cations was determined with a relative standard deviation of about 2%. Sulfate and small amounts of fluoride do not interfere. (auth)

11538 AMPEROMETRIC TITRATION OF THORIUM IN MONAZITE SANDS. J. J. Burastero and R. W. Martres (Administración Nacional de Combustibles, Pando, Uruguay). Anal. Chem., 34: 378-81(Mar. 1962).

A practical method for the separation and amperometric determination of thorium in monazite sands is proposed. The attack is carried out with sulfuric acid on 10-gram samples; thorium and the rare earths are separated by a single precipitation with oxalic acid, and the final amperometric titration is made with ammonium paramolybdate as titrant. The composition of the thorium molybdate precipitated, as a function of the initial concentration of thorium, is verified. Possible interferences of some impurities that frequently occur in these sands are determined. The results agree with those of the iodate chemical method and other more laborious amperometric techniques. (auth)

11539 SPECTROGRAPHIC SOLUTION PROCEDURES FOR THE DETERMINATION OF SOME LESS FAMILIAR ELEMENTS IN IRON AND NICKEL BASE ALLOYS. J. P. McKaveney and G. L. Vassilaros (Crucible Steel Co. of America, Pittsburgh). Anal. Chem., 34: 384-8(Mar. 1962).

Spectrochemical analysis by the solution-rotating disk technique is proposed for the determination of less familiar elements in typical iron and nickel base alloys to relieve the wet chemist from the long and difficult task of developing a separation scheme for each new alloy composition. Chemical procedures required for the sample solution preparation are outlined for beryllium, niobium, magnesium, silver, yttrium, and zirconium. Chemical aspects of the solution are empirically examined both from the view of solvent effect on spectrographic response and chemical interaction between solvent and metallic ion. (auth)

11540 OXIDIMETRIC DETERMINATION OF URANIUM(III) AND (IV) WITH LEAD TETRAACETATE. A. Berka, J. Dolezal, I. Nemec, and J. Zýka (Charles Univ., Prague). Anal. Chim. Acta, 26: 148-54(Feb. 1962). (In German)

Uranium(III) or (IV) can be determined by reaction with iron(III) solution in hydrochloric acid medium, the iron(II) produced being titrated potentiometrically with lead tetraacetate solution. As little as 20μg of uranium(IV) can be determined accurately in a volume of 30 ml. (auth)

11541 A METHOD FOR HIGH-PRECISION ASSAY OF URANIUM METAL. J. A. Duckitt and G. C. Goode (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Analyst, 87: 121-4(Feb. 1962).

A method is described for the rapid determination of uranium in natural and enriched uranium. Reduction of uranium(VI) to uranium(IV) is avoided by solution of the

metal in orthophosphoric acid, and precipitation of uranous phosphate is precluded by careful control of acidity. A weighed excess of potassium dichromate is added, and the excess is titrated potentiometrically with standard ferrous solution added from a weight-burette. The procedure has a standard deviation of 0.02%, and it was necessary to use uranium metal of known purity as a primary standard. The effects of some interfering elements were studied. (auth)

11542 THE ANALYSIS OF URANIUM ALLOYS USING A HOLLOW CATHODE. Joseph A. Goleb and James K. Brody (Argonne National Lab., Ill.). Appl. Spectroscopy, 15: No. 6, 166-70(1961).

Investigations made with the Schüller-Gollnow water-cooled hollow-cathode tube for the purpose of using it as an analytical source to analyze fuel materials employed in nuclear reactors are described. A number of unirradiated normal and enriched uranium alloys were tested with the tube using a 21-ft, Wadsworth, Jarrell-Ash grating spectrograph and photographic plates. Results obtained for molybdenum, ruthenium, rhodium, and palladium, in the range of 2.5, 2.0, 0.3, and 0.2% respectively, compare favorably with the point-to-plane technique. (auth)

11543 THE SPECTROCHEMICAL DETERMINATION OF TRACE IMPURITIES IN GRAPHITE. J. A. Goleb, J. P. Faris, and B. H. Meng (Argonne National Lab., Ill.). Appl. Spectroscopy, 16: 9-12(1962).

Optical emission spectrographic procedures are described for the estimation of some 60 elements in graphite. Using sodium fluoride as a carrier, the d-c arc was employed for a direct examination of powdered graphite, while the copper spark method was used for analysis of the residue after ashing the sample. (auth)

11544 ANALYSIS OF AIR SAMPLES FOR BERYLLIUM BY THE ROTATING PLATFORM SPECTROGRAPHIC TECHNIQUE. G. V. Wheeler, W. A. Ryder, and K. R. Arnold (Phillips Petroleum Co., Idaho Falls, Idaho). Appl. Spectroscopy, 16: 17-19(1962).

Beryllium was determined spectrographically on air sample filter papers by direct sparking of the filter paper mounted on a silver disk which revolves on a rotating platform electrode apparatus eccentric from a silver counter electrode. The procedure is fast and precise with a minimum of sample handling and can be used with samples containing as little as one mμg of beryllium. (auth)

11545 THE USE OF THE $(\alpha,n\gamma)$ REACTION IN DETERMINING THE CONTENT OF BERYLLIUM IN MINERAL CONCENTRATES. I. N. Plaksin, M. A. Belyakov, and L. P. Starchik (Stochinskii Mining Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 374-6(Jan. 11, 1962). (In Russian)

The analysis of Be by a (γ,n) reaction with the use of an Sb^{124} source is highly selective, but suffers from the disadvantage that a large amount of shielding and a large amount of sample are required. The (α,n) reaction with the use of a Po-Be or a Ra-Be source is suitable except when fluorite is presented in the concentrate. The interferences from boron, fluorine, or lithium in the determination of Be by an (α,n) reaction can be avoided by counting the hard gamma rays (4.45 and 7.65 Mev) which are emitted by the excited nucleus of C^{12} which is formed as an intermediate: $Be^9 + He^4 \rightarrow C^{12} + n^1$. A single-channel, NaI scintillation counter with a discriminator setting of 15 volts cuts out the 0.8 Mev gamma from the Po^{210} source, and counts only the hard gammas from the excited C^{12} nucleus. Mixtures of $Be_3Al_2(Si_6O_{18})$ and fluorite (CaF_2) were irradiated from an alpha source, and it was found that the gamma count (4 Mev or higher in energy) was directly proportional to the Be content. The presence of fluorite did not interfere with the analysis. The relative error did not exceed 15% for a 1% BeO content and a 30 min. counting time. If the activity of the α-source is increased from 5 mc to about one curie, a few hundreths of a percent of BeO can readily be determined in alloys or in solution. (TTT)

11546 MONITORING ATMOSPHERIC SO_2 EMPLOYING INVERSE RADIOACTIVE TRACERS. Richard L. Bersin, Frederick J. Brousaides, and Carlton O. Hommel (Tracerlab Keleket, Waltham, Mass.). J. Air Pollution Control Assoc., 12: 129-37; 146(Mar. 1962).

A proposed method for monitoring atmospheric sulfur dioxide is discussed. Krypton-85 is used as an inverse radioactive tracer. It is postulated that the method may be developed into a simple, portable, and relatively inexpensive monitor adaptable to laboratory or field use. (C.H.)

11547 THE DETERMINATION OF ISOTOPIC RATIO OF U^{235}/U^{238} BY NEUTRON ACTIVATION. Tomitaro Ishimori and Takeo Fujino (Japan Atomic Energy Research Inst., [Tokyo]). J. At. Energy Soc. Japan, 4: 16-24(Jan. 1962). (In English)

The isotopic ratio of U^{235}/U^{238} was determined by neutron activation analysis without any tedious chemical separation. However, the irradiation of uranium sample was limited to some particular conditions because of the high fission cross section value for U^{235}. 100 mg of uranium oxide-oxalic acid mixture (1 :8000) was irradiated for 1 hr. After cooling for one day, the γ activity of the sample was studied spectrometrically. The dilution of uranium sample with a large amount of oxalic acid gave various advantages in slowing down fast neutrons, in capturing recoil fission products, or in taking very small amounts of uranium for irradiation. Two methods are proposed and compared. The first method is based on the relative ratio between activities in the energy region containing γ-activity due to Np^{239} and those in the higher energy region free from the activity of Np^{239}. In the second method, the strength of γ-activity due to fission products is measured as the amount related closely to the U^{235} concentration. (auth)

11548 CHROMATOGRAPHY ON PAPER IMPREGNATED WITH ION EXCHANGE RESINS. V. THE STUDY OF COMPLEX EQUILIBRIA. G. Alberti, V. Caglioti, and M. Lederer (Instituto di Chimica Generale ed Inorganica, Rome). J. Chromatog., 7: 242-6(Feb. 1962). (In English)

The use of resin papers permits an extremely fast and simple determination of the charge on a complex as well as an estimation of the type of complexing reaction. The method is limited to those concentrations which yield intermediate R_F values on the resin paper. It was possible to confirm previous work indicating that AlF_2^+ is the main species present in HCl–HF mixtures; however, evidence was obtained that also AlF^+ should exist in solutions containing only very little HF (0.025 M and less). (auth)

11549 QUANTITATIVE INORGANIC CHROMATOGRAPHY. PART VIII. THE QUANTITATIVE ANALYSIS OF THE ALKALINE-EARTH METALS BY PAPER CHROMATOGRAPHY AND FLAME SPECTROPHOTOMETRY. F. H. Pollard, E. E. H. Pitt, and G. Nickless (Univ. of Bristol, Eng.). J. Chromatog., 7: 248-54(Feb. 1962). (In English)

A paper-chromatographic procedure is described for the quantitative analysis of microgram amounts of barium, strontium, calcium, and magnesium. After separation, the metals are extracted and determined flame spectrophotometrically. (auth)

11550 CO-PRECIPITATION OF FRANCIUM AND CAESIUM WITH HETEROPOLYACIDS. V. Kouřim (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež and Prague), A. K. Lavrukhina, and S. S. Rodin. J. Inorg. & Nuclear Chem., 21: 375-9(Dec. 1961).

Tests on the precipitation of very small quantities of Fr and Cs with di-heteropolyacids (di-HPA) under various reaction conditions and the determination of the degree of coprecipitation with some tri- and tetra-HPA with various central atoms and ligands were made. The highest co-precipitation yields were obtained with di- and tri-HPA where W and Mo ligands were bonded to a central P or As atom. The lowest yields occurred with HPA with central B, Ge, or Se atoms. In most cases the presence of V in the HPA molecule led to lower yields. Francium was better precipitated that Cs, but this was probably due to the small difference between Fr and Cs ionic radii. Coprecipitation with carrier was also investigated. (P.C.H.)

11551 DETERMINATION OF TOTAL P^{32} IN LIVING LARVAE OF TENEBRIO MOLITOR L. (COLEOPTERE: TENEBRIONIDAE). L. Hout and W. G. Verly (Université, Liège). J. Insect Physiol., 4: 202-8(1960). (In French)

It is possible to determine total P^{32} in living larvae of Tenebrio molitor with an error of ±5%, which is related specially to the error in the correction factor utilized. The very small variation of this correction factor in relation to the weight of larvae is discussed. (auth)

11552 ELECTRON-PROBE MICROANALYSIS OF RADIOACTIVE SAMPLES. QUANTITATIVE ANALYSIS OF THE PLUTONIUM–IRON SYSTEM. V. D. Scott and G. V. T. Ranzetta (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Inst. Metals, 90: 160-7(Feb. 1962).

Techniques suitable for the examination of radioactive specimens by electron-probe microanalysis are presented with illustrations and assessed. Quantitative results from a series of alloys containing iron and the heavily absorbing element plutonium showed large differences between the measured iron contents and the true values. These differences, which are dependent upon the probe voltage, are discussed with particular reference to absorption and fluorescence effects. The value of the present results as a guide to the analysis of similar systems is considered. (auth)

11553 THE USE OF SINGLE-CHANNEL SCINTILLATION GAMMA SPECTROMETER FOR RADIOACTIVITY. Bohumil Žitňanský and Imrich Šebestián. Jaderná energie, 8: 9-14(1962). (In Czech)

Some possibilities of the use of scintillation gamma spectrometry in the field of polycomponent radioisotope systems are indicated. Systems of Fe^{59}, Mn^{54}, Cr^{51}, and W^{181} were analyzed quantitatively without preliminary separation. Gamma spectra of various sources are reported. The single-channel scintillation gamma spectrometer SGXA-3 is briefly described. (auth)

11554 PHYSICS AND TECHNOLOGY OF MASS SPECTROSCOPIC ANALYSIS. VII. MASS SPECTROSCOPIC ANALYSIS OF SOLID SUBSTANCES. Hans Voshage (Max-Planck-Institut für Chemie, Mainz). Kerntechnik, 3: 537-42(Dec. 1961). (In German)

The most important fields of application are determinations of relative isotopic frequencies of elements present in the form of solid components, determinations of trace elements in solids by the isotopic dilution method, and complete analyses by the spark-ion method. Electromagnetic mass separators for the production of stable isotopes and dual-focussing mass spectrographs are briefly discussed. (auth)

11555 THE CONTINUOUS DETECTION OF LOW TRITIUM TRACES IN AIR AND IN OTHER REACTOR GASES. (to Kernreaktor Bau- und Betriebs G.m.b.H.). German Patent DAS 1,074,880. Kerntechnik, 3: 552 (Dec. 1961). (In German)

A method for the detection of tritium traces in air and other reactor gases is given. According to the proposal, tritium steam is thermally decomposed over heated tungsten or magnesium, the tritium is separated from other gases by diffusion over a nickel or palladium tube, and its radiation intensity is measured with a Geiger tube. If the gas containing the tritium steam has a high oxygen content, then the water vapor must be separated by diffusion through a hydrate cellulose foil permeable only to water before the thermal decomposition of the steam. A sketch of the circuits is given in order to clarify the process. (J.S.R.)

11556 A VISUAL METHOD OF DETERMINING TRACE-LEVEL ACTIVITIES. V. K. Lyapidevskii and T. G. Pavlova (State Scientific-Research Inst. of Roentgen-Radiology, Ministry of Public Health, USSR). Med. Radiol., 6: No. 11, 66-71(Nov. 1961). (In Russian)

A description is given of a visual method for determining trace-level gamma activities with the aid of a convection chamber. Measurements of trace-level activity were effected on large surfaces, in preparations in 4-π geometry, on short-lived radioactive elements, and in atmospheric samples. By assessing the gamma range in alcohol and aluminum, alpha-active substances were identified. (auth)

11557 A NEW RAPID METHOD OF DETERMINING THE CONTENT OF Sr^{90} IN THE BONES. M. M. Golutvina, T. A. Kazakova, Yu. M. Nikolaev, N. V. Markelova. Med. Radiol., 7: No. 1, 62-7(Jan. 1962). (In Russian)

A new method is described for determining the content of radiostrontium in bones of man and animals. The method makes it possible to conduct 2 to 4 analyses during one day. Information pertinent to the relative merits of the method is included. (auth)

11558 RADIOCHEMICAL DETERMINATION OF Cs-137 IN WEAK ACTIVITY SAMPLES. V. P. Shvedov, M. I. Zhilkino, and V. K. Zinov'eva. Radiokhimiya, 3: 732-6 (1961). (In Russian)

Optimum conditions are found for determining the amount Cs^{137} in atmospheric precipitation. Triple solvent precipitation of fission product carriers (Fe, Sr, Ce, Y, and Zr) with macrocomponent admixtures (Na, K, Mg, Co, Cu, Ni, and others) achieves the separation of Cs^{137}. (R.V.J.)

11559 ORGANIC CO-PRECIPITANTS. XV. CO-PRECIPITATION OF AMERICIUM. V. I. Kuznetsov and T. G. Akimova. Radiokhimiya, 3: 737-42(1961). (In Russian)

A quantitative coprecipitation of trivalent americium at pH 5 to 8 was achieved using arsenazo, benzene-2 carboxy < 1 azo-7 > -1.8 dioxynaphthalene-3.6 disulfoacid, eriochrome black T reacting with methyl violet, crystal violet, or methylene blue. A quantitative precipitation was observed with a dilution of $1:1 \times 10^{12}$ (0.0002 γ Am in 200 ml). It is also shown that Am is coprecipitated with low-solubility oxalate formed by 1.8 diaminonaphthalene cation. (R.V.J.)

11560 DIRECT DETERMINATION OF PROTACTINIUM AND ACTINIUM IN URANINITES. I. E. Starik, F. E. Starik, and A. N. Elizarova. Radiokhimiya, 3: 749-54(1961). (In Russian)

A direct determination was made of protactinium and actinium in uraninites, and a radioactive equilibrium between AcU and Pa was established within the accuracy limits of the method. The data on the Pa and Ac contents of uraninites indicate that both elements are found in radioactive equilibrium. (R.V.J.)

11561 THE ANALYSIS BY RADIOELEMENTS OF VERY HIGH PURITY ALUMINUM OBTAINED BY THE TECHNIQUE OF ZONE MELTING. G. Chaudron (C.N.R.S., Paris). Rec. trav. chim., 79: 502-9(June 1960). (In French)

The radioelement technique was applied in identifying trace impurities in very pure metal. The method was applied to aluminum purified by zone melting. The analyses permitted the determination of more than 40 elements, among them the rare earths. (tr-auth)

11562 THE DETERMINATION OF TUNGSTEN IN HIGH ALLOY STEELS BY ISOTOPE DILUTION. G. Leliaert, J. Hoste, and Z. Eeckhaut (Universiteit, Ghent). Rec. trav. chim., 79: 557-66(June 1960). (In English)

An isotope dilution procedure using W^{185} was developed for the determination of tungsten in high alloy steels. Tungsten is determined spectrophotometrically with hydroquinone in sulfuric acid medium, after homogeneous precipitation from a nitric acid hydrogen peroxide solution. For molybdenum–vanadium–tungsten alloy steels no further chemical separations are required. The radiometric correction is applied to the residual tungsten so as to minimize counting errors. Analyses carried out on NBS samples showed good accuracy and precision. For high alloy steels containing niobium, tantalum, and titanium a chemical separation of tungsten is necessary to avoid interference in the subsequent spectrophotometric determination. Although the recovery of tungsten is quite low, the magnesia method is entirely satisfactory. The method was successfully tested on a number of NBS high alloy steels to which varying amounts of tantalum and titanium were added. (auth)

11563 ANALYTICAL STUDY OF SEBACIC AND TETRACHLOROPHTHALIC ACIDS IN VIEW OF THORIUM DETERMINATION. Paul E. Wenger and I. Kapétanidis (Université, Geneva). Rec. trav. chim., 79: 567-73(June 1960). (In French)

Thermodynamic dissociation constants were determined for some sebacic ($pk_1 = 4.40$, $pk_2 = 5.22$) and tetrachlorophthalic (pk_1 = high, $pk_2 = 2.94$) acids. At the same time, the solubilities of some sebacates and chlorophthalates of Th, Ce, La, and Pr were also determined. The theoretical solubility products calculated corresponded to the experimental values obtained. (tr-auth)

11564 THE DETERMINATION OF URANIUM AND OF THORIUM IN THEIR COMPOUNDS BY GAMMA RADIATION MEASUREMENTS. A. E. Korvezee (Technological Univ., Delft, Netherlands). Rec. trav. chim., 79: 617-21(June 1960). (In English)

Radiometric determination of uranium and of thorium in their compounds can be effected in principle by gamma counting with a scintillation spectrometer. The complications that arise when the radioactive equilibrium with the daughter products in the samples to be analyzed is not established, are discussed. (auth)

11565 ANALYSES OF SMALL SAMPLES OF MONAZITES WITH A GAMMA SCINTILLATION SPECTROMETER. G. H. M. Couwenberg, C. L. D. Kooy, and A. E. Korvezee (Technological Univ., Delft, Netherlands). Rec. trav. chim., 79: 895-909(Aug. 1960). (In English)

The possibility of applying gamma ray analysis to approximately 50 mg samples of monazite was investigated. Three ranges of low energy gamma radiation, under 0.3 Mev, were counted with a gamma scintillation spectrometer. This extremely simple method led to very good results with samples containing only one radioactive component. With monazites containing uranium as well as thorium, the latter component being in excess, results were also good. For uranium contents that were only a few tenths of a per cent, the results did not attain the precision of chemical analysis. In a leached mineral where the simultaneous contents of uranium, radium in excess, and thorium had to be determined, the method failed, due to the smallness of the contribution of UX in the emitted radiation with respect to that of the radium family. In this case we were able to calculate an approximate value for the thorium content and make a rough estimate of the total radium content of the mineral. With this spectrometer the use of longer counting times gives only a slight improvement in the precision of the counts. The use of somewhat larger samples will however diminish the important background fraction in the low activity countings and hence it will give a corresponding increase in the reliability of the results. (auth)

11566 DETERMINATION OF Ti AND Fe IN Fe AND Ti–Zr ORES. L. N. Lyubimov and V. G. Sochevanov (All-Union Inst. of Mineral Resources, USSR). Zavodskaya Lab., 28: 15-17(1962). (In Russian)

Polarographic determination of high-content Ti and Fe in 5M H_3PO_4 and 1M H_2SO_4 is described. The presence of Zr, Nb, and Ta do not interfere with the determination. (tr-auth)

11567 DETERMINATION OF Ni AND Mo. G. P. Protsenko and P. N. Kovalenko (Rostov State Univ., USSR). Zavodskaya Lab., 28: 23-5(1962). (In Russian)

Electrolytic separation of Ni and Mo in sulfuric acid at pH = 4.1 to 3.3 with a 24-v potential is described. Mo is precipitated as $2Mo_2O_3 \cdot 13H_2O$ and Ni is separated electrolytically in ammonia. (R.V.J.)

11568 DETERMINATION OF Y BY K EDGE ABSORPTION USING Tm^{170}. V. Yu. Zalesskii and S. M. Przhiyalgovskii (All-Union Inst. of Scientific Research on Mineral Resources, USSR). Zavodskaya Lab., 28: 35-9(1962). (In Russian)

A Tm^{170} source was used in the x-ray spectrometric determining yttrium by K-edge absorption. The analysis does not depend on the content of the specimen and can be carried out in relatively thick layers. The order of accuracy is 4%. (tr-auth)

11569 IMPROVED SENSITIVITY OF SPECTRAL ANALYSIS WITH LUMINESCENCE SUBSTANCES. L. Ya. Khlebnikova, V. N. Vasil'eva, and L. A. Dvorzhetskaya (State Inst. of Applied Chemistry, USSR). Zavodskaya Lab., 28: 45-6(1962). (In Russian)

The sensitivity of spectral analysis for Ni and Co was improved by a factor of 2 (10^{-6}%) through an evaporation enrichment of zinc and cadmium sulfide admixtures and by a chemical enrichment of cadmium selenide. The evaporation method proved simpler and more efficient. (tr-auth)

11570 DETERMINATION OF CERIUM IN CAST IRON BY TITRATION WITH A HYDROQUINONE SOLUTION. A. A. Amsheeva and D. V. Bezuglyi (Khar'kov Polytechnical Inst. and Malyshev Transport Machine-Building Plant, USSR). Zhur. Anal. Khim., 16: 683-7(Nov.-Dec. 1961). (In Russian)

A simple method was proposed for the quantitative separation of cerium with sodium fluoride. A rapid titrimetric method was developed for the determination of cerium with a hydroquinone solution. Treatment of the analytical data

by the method of mathematical statistics has shown the absence of a systematical error and the high accuracy of the results. Cerium determination by the proposed method requires 5 to 6 hours. (auth)

11571 DETERMINATION OF TITANIUM IN TITANIUM CARBIDE–VANADIUM ALLOYS. E. E. Kotlyar and T. N. Nazarchuk (Inst. of Metalloceramics and Special Alloys, Academy of Sciences, Kiev). Zhur. Anal. Khim., 16: 688-91(Nov.-Dec. 1961). (In Russian)

Conditions are given for precipitating vanadium with sodium diethyldithiocarbamate in the presence of tartaric, citric, and oxalic acids and ammonia fluoride. The complete separation of titanium and vanadium by precipitation with sodium diethyldithiocarbamate in the presence of citric and tartaric acids or ammonium fluoride is possible at pH 2 to 3, 3 to 4, and 5 to 6 respectively. A method for the analysis of titanium carbide-metallic vanadium systems was developed. (auth)

11572 AMPEROMETRIC TITRATION OF VANADIUM AND URANIUM WITH TITANIUM(III) SALTS. Z. A. Gallai and N. M. Sheina (Moscow State Univ.). Zhur. Anal. Khim., 16: 706-8(Nov.-Dec. 1961). (In Russian)

An amperometric method was developed for the titration of vanadium(IV) with titanium(III) in pure salts and in the presence of chromium, manganese, and titanium. Conditions were found for the amperometric determination of uranium using titanium(III) in the presence of titanium(IV) up to the U : Ti ratio 1 : 100. (auth)

11573 QUANTITATIVE DETERMINATION OF URANIUM IN ORES BY AN OSCILLOGRAPHIC POLAROGRAPHY METHOD. D. I. Ryabchikov, Ya. P. Gokhshtein, and Ts'ai-shêng Kao (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim., 16: 709-14(Nov.-Dec. 1961). (In Russian)

It is shown that oscillographic polarography may be used for the determination of uranium in certain ores without the separation of accompanying elements. (auth)

General Inorganic and Physical Chemistry

Refer also to abstract 11456

11574 (AERE-R-3938) THE PREPARATION, STABILISATION AND ANALYSIS OF URANIUM (IV) NITRATE SOLUTIONS. R. J. W. Streeton and E. N. Jenkins (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1962. 10p.

Hydrazine and urea are considered as alternatives to sulfamic acid to stabilize uranium(IV) nitrate solutions. All three stabilizers act as nitrite destroyers in reactions which involve evolution of nitrogen gas. A comparison of the rates of the nitrite-stabilizer reactions shows that urea is greatly inferior to either hydrazine or sulfamic acid. Sulfamic acid has the important disadvantage of introducing sulfate into the plant effluents, so hydrazine is the stabilizer to be preferred. In liquid-liquid extraction, the nitrite may occur chiefly in the organic phase and the stabilizer chiefly in the aqueous; reaction then occurs mainly in the vicinity of the interface. Hydrazine may also be used as a nitrite destroyer in the production of uranium(IV) nitrate by electrolysis of uranyl nitrate solution at a mercury cathode. 80% conversion is readily achieved. Small quantities of the solutions so obtained re-oxidize slowly at a rate not greater than 5% per week. Of three analytical methods tested for uranium(IV), an absorptiometric method based on reduction of iron(III) and complexing of iron(II) with o-phenanthroline at pH 3 to 5 was shown to be the best for either aqueous or organic samples. (auth)

11575 (ANL-6250) STUDIES OF METAL–WATER REACTIONS AT HIGH TEMPERATURES. II. TREAT EXPERIMENTS: STATUS REPORT ON RESULTS WITH ALUMINUM, STAINLESS STEEL-304, URANIUM, AND ZIRCALOY-2. Robert C. Liimatainen, Richard O. Ivins, Marshall F. Deerwester, and Frank J. Testa (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-Eng-38. 171p.

A study is being conducted on the behavior of nuclear fuel materials subjected to neutron bursts of sufficient energy to achieve a meltdown in a water environment. The metals of main interest in water-cooled reactor technology, namely, aluminum, stainless steel-304, uranium, and Zircaloy-2, are being investigated in this in-pile, fuel-meltdown program. The fuel-specimen geometries examined so far were either cylinders or plates. Metallurgically, the fuel specimens tested were of the following three types: metal core (clad or unclad), oxide core (metal clad), and cermet core (clad or unclad). By submerging the fuel in water during a neutron pulse, a power excursion resulting in a meltdown incident was simulated. The fuel specimen, contained in a stainless steel autoclave (200-cc volume) was exposed to a radiation pulse in TREAT (Transient Reactor Test Facility). During the experiment, the temperature of the metal, the pressure in the autoclave, and the reactor power were recorded on an oscillograph. The fuel specimen was heated from room temperature to melting in intervals as short as 0.3 sec. After the irradiation, the extent of metal-water reaction was determined by a mass spectrographic analysis for the hydrogen produced. The thermal neutron dose of the fuel specimen was determined by the activation and counting of gold foils. The specific energy input was estimated after the irradiation, by direct radiochemical analysis for certain fission products. Macro and micro photographs were taken of the melted samples to note physical and structural changes. The data obtained with uranium wires and pins indicated that both the reactor period and integrated power are of importance in determining the amount of metal-water reaction that occurs. For 64-mil-diameter uranium wires in water, the extent of uranium-water reaction (with 216 cal of energy input per gram of uranium) increased from 0.4 to 7.5 to 17.2% as the reactor period changed from 515 to 267 to 96 msec, respectively. Peak uranium wire temperatures up to 1500°C were recorded. Particle size measurements after melting of the uranium wires showed that the bulk of the particles ranged from 2 to 16 mils; the data were presented as size-frequency distributions. The energetic meltdowns caused the specific surface area to increase relative to the original area up to a factor of five. Meltdown results from uranium wires and uranium pins (20% enriched, 0.2-in. diameter) indicated an increase in the metal-water reaction as the reactor burst became more energetic. At reactor periods of about 100 msec, bursts less energetic than 50 cal/g uranium did not melt the fuel pin. At burst of 50 to 100 cal/g, the pin was partially melted (1133°C). Transients more energetic than 100 cal/g resulted in complete melting of the uranium. The correlated data on extent of the uranium–water reaction as a function of energy are presented. These results show that the relative contribution of chemical to nuclear energy increases linearly with the energy of the reactor burst for transients which initiate molten uranium-water reactions. Reactor bursts more energetic than 150 cal/g uranium resulted in extensive formation of globules and fine particles. It was observed that

the dispersion of the molten metal could be increased by canning the uranium alloy core in a Zircaloy-2 jacket, which has a higher melting point, and providing a pin hole through which the molten core metal could spray. The data obtained from the in-pile experiments on cermet and mixed oxide core fuel pins were correlated as a function of the energy of the reactor burst in cal/g of core in the fuel pin. The uranium in these mixed oxide and cermet core pins was 93% enriched with U^{235}. The mixed oxide core had the composition 81.5 wt % zirconia, 9.1 wt % calcia, 8.7 wt % urania, and 0.7 wt % alumina. The core pellets had a diameter of 0.33 in. and were 0.50 in. long. The metal jackets had a 20-mil wall thickness. For the fuel pins with mixed oxide core, the energy in cal/g of core was 0.94 times the number of megawatt-seconds. From these comparisons on the high-temperature reactions of cladding metals with water, it appeared that zirconium is the most reactive. Stainless steel cermet pins gave more metal-water reaction than aluminum cermet pins. For each of the three metals, the amount of reaction went up as the burst became more energetic. It was also observed that the energy of the reactor burst that was required to cause failure (such as rupture or melting) of the oxide-core, metal-clad fuel pins depended on the metal used for the cladding. The peak, adiabatic temperature at the center of the mixed oxide core corresponds to 2550°C for an energy input of 395 cal/g core with the fuel pin initially at 25°C. Experiments with fuel pins having a pure uranium dioxide core clad in stainless steel-304 showed similar changes in geometry to meltdowns conducted on fuel pins with mixed oxide core. For these uranium-dioxide-core fuel pins, 174 cal/g UO_2 (2200°C maximum adiabatic temperature) was the threshold energy between destructive and nondestructive transients. (auth)

11576 (ASD-TR-7-840A(IV)) HYDRAZINE PROCESS DEVELOPMENT. Interim Technical Engineering Report, November 1961 through January 1962. L. G. Carpenter, R. I. Miller, R. L. Pearson, F. R. Standerfer, H. J. Snyder, and H. T. Watanabe (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AF33(600)-42996. 198p.

Activities are reported in a program to develop, design, construct, and operate a continuous in-reactor, hydrazine production loop based on fissio-chemical principles. In processing development, the storage, mixing, delivery, sampling, and waste disposal systems for ammonia, hydrazine, and nitrogen are about complete. Direct methods of producing UO_2 particles with 1 to 2 micron diameter are being investigated, and irradiation tests are being scheduled. Design work on the in-pile loop is described and data from measurement of fission fragment energy spectra are presented. (J.R.D.)

11577 (CEA-BIB-27) HYDRURE DE ZIRCONIUM. (Zirconium Hydride). J. Dirian (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1962. 11p.

A bibliography containing 114 references on the preparation and various properties of zirconium hydride. The references are arranged in chronological order. An author index is included. (auth)

11578 (DP-621) THE STABILITY OF PuF_3 IN THE TRIFLUORIDE PRECIPITATION PROCESS. John A. Porter (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1961. Contract AT(07-2)-1. 11p.

Plutonium trifluoride was found to be highly resistant to oxidation during and after precipitation, provided the precipitate was kept slurried in the supernatant solution. Oxidation occurred when the trifluoride was permitted to settle in static layers. An ultrasonic cleaning technique was developed that was very effective in removing deposited plutonium trifluoride from precipitation equipment. (auth)

11579 (TID-15075) [PREPARATION OF STABLE ORGANOBORON COMPOUNDS FOR USE IN NEUTRON IRRADIATION THERAPY]. Technical Progress Report. Michael J. S. Dewar (Chicago. Univ.). [1961]. Contract AT(11-1)-889. 19p.

The preparation of stable organoboron compounds that might be of value in neutron irradiation therapy is discussed. Experiments are described that led to the preparation of a series of aminoalkyl derivatives of 2-methyl-2:1-borazaronaphthalene and 2-methyl-2:1-borazaraphenanthrene, two ring systems which show a stability of a different order to normal organoboron compounds as a result of their aromatic nature. Larger quantities of six of these compounds were prepared for biological testing. Attempts were also made to prepare a boron-containing purine analog; these were unsuccessful. (auth)

11580 (TID-15080) PHASE RELATION IN THE SYSTEM URANIUM TRIOXIDE–NITRIC ACID–WATER AT VARIOUS TEMPERATURES. J. R. Lacher, Keith Ensley, and J. D. Park (Colorado. Univ., Boulder). [1960]. Contract [AT(11-1)-753]. 5p.

Phase studies of the $UO_3-HNO_3-H_2O$ system were extended into the HNO_3-rich region and at higher temperatures. A schematic diagram is given. It is shown that the hexahydrate has the greatest solubility while the dihydrate shows the least solubility. In the acid-rich region the acid decomposes, and it becomes impossible to study the system in three components. (M.C.G.)

11581 (TID-15081) SOME PHOTOCHEMICAL AND THERMODYNAMIC PROPERTIES OF URANYL COMPLEXES. Technical Progress Report. John R. Lacher and Joseph D. Park (Colorado. Univ., Boulder). Feb. 1962. Contract AT(11-1)-753. 31p.

An experimental isothermal calorimeter which utilizes Peltier cooling to compensate and measure the heat of reaction was designed and built. Vapor pressure measurements using the gas saturation method were made on aqueous uranyl nitrate at 25°C from 0.15 molal to saturation. The experimental data confirmed that of Robinson and Lim and showed no anomalous curve as was previously observed at 0°C. (M.C.G.)

11582 (AEC-tr-5039) THE DIFFUSION OF RADIOACTIVE SUBSTANCES THROUGH SOLIDS OF GRANULAR STRUCTURE. Eberhard Kern and Alfred Schatz. Translated from Nukleonik, 3: 61-76(May 1961). 39p.

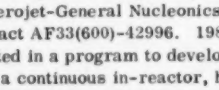
This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 24132.

11583 (AEC-tr-5040) CHEMICAL STABILITY OF CARBIDES OF THE TRANSITION ELEMENTS OF THE IV, V, AND VI GROUPS. V. P. Kopylova. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.) from Zhur. Priklad. Khim., 34: 1936-9(Sept. 1961). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 2952.

11584 (CEA-tr-R-1421) ECHANGEURS D'IONS A BASE DE ZIRCONIUM. (Ion Exchangers on Basis of Zirconium). S. E. Bresler, Yu. (In.) D. Sinochkin, A. I. Egorov, and D. A. Perumov. Translated into French from Radiokhimiya, 1: 507-13(1959). 24p.

Data are given on the ion-exchange properties of some amorphous compounds of Zr, namely chains of the form



with attached sulfide, chromate, arsenate, oxalate, or carbonate groups. These com-

pounds are shown to be capable of quantitatively separating several mineral ions (e.g., Ca^{2+} from Cu^{2+}, Sr^{2+}, Co^{2+}, La^{3+}, and Mg^{2+}). The existence of selectively acting acidic groups permits the attainment of an appreciable enrichment in the course of a direct sorption process. (T.F.H.)

11585 (FTD-TT-62-14) THE DETERMINATION OF RATE CONSTANTS OF ELEMENTARY REACTIONS OF HYDROGEN ATOMS. L. I. Avramenko and R. V. Kolesnikova. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, 1971-6(1961). 13p.

The rate constants of the reactions $H + H + H_2 \rightarrow 2H_2$ and $H + O_2 + H_2 \rightarrow HO_2 + H_2$ were determined to be 5.2×10^{-32} and 1.2×10^{-33} $cm^6sec^{-1}molecules^{-2}$, respectively. Comparisons are made with literature values. The EPR spectrum of the HO_2 radical frozen from the gaseous phase was recorded at the temperature of liquid N_2. The HO_2 radical is converted fairly rapidly into H_2O_2 according to the reaction $2HO_2 \rightarrow H_2O_2 + O_2$. (D.L.C.)

11586 (JPRS-12342) THE MAGNETIC AND ELECTRICAL PROPERTIES OF MACROMOLECULES. L. A. Blyumenfel'd. Translated from Priroda, 50: No. 2, 55-9 (1961). 8p.

An experiment is described in which complexes of ribonucleic acid (RNA) or deoxyribonucleic acid (DNA) and albumin preparations, which did not singly produce any electronic paramagnetic resonance (EPR) signals, were dissolved in a buffer solution. The complex and albumin give a broad EPR signal. Further experimentation led to the conclusion that at specific stages in cell growth, presumably at division, the pseudoferromagnetic properties of nucleoproteins increase sharply increasing the intensity of the broad EPR signals. Electric properties in the cells are also believed to change at the same time. (J.R.D.)

11587 (SCL-T-402) ON THE THEORY OF CHEMISORPTION. O. Jaetsch. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Phys. and Chem. Solids, 21: 33-9(Oct. 1961). 16p.

The isotherm, isoster, and isobar of chemisorption are derived on the assumption that during the chemisorption process, a charge is exchanged between the molecules and the adsorbent or the catalyst. The lifetime of the chemisorbed molecules is determined by considering small deviations of the density of the adsorbed molecules from the equilibrium value. This lifetime determines the rate (velocity) of the chemisorption operation. The "active centers," responsible for the adsorption, are probably the free valences of the surface atoms. The position of the energy levels of these centers, relative to the electrochemical potential, determines the transmission coefficients of the various charge transitions. (auth)

11588 (UCRL-Trans-783) ON THE PROBLEM OF THE THEORY OF SURFACE IONIZATION. L. N. Dobretsov. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Trudy Leningrad. Politekh. Inst. im M. I. Kalinina, No. 194, 143-53 (1958). 33p.

A review and analysis of a series of articles by G. M. Avak'yants on the theory of surface ionization are presented. The articles report investigation of the conditions at which surface ionization occurs with an ionization potential on the surface of a solid body with work function so that the degree of ionization is not determined by the Langmuir-Saha equation. (J.R.D.)

11589 THE CRYSTAL STRUCTURE OF $LiHF_2$. L. K. Frevel and H. W. Rinn (Dow Chemical Co., Midland, Mich.). Acta Cryst., 15: 286(Mar. 10, 1962).

Powder diffraction data obtained with filtered CuKα radiation in a cylindrical camera are given. The pattern of $LiHF_2$ was indexed on the basis of the $F5_1$ structure. The method for preparing the sample is described, and the sample as prepared contained approximately 10 wt % LiF, which served as a useful internal standard for film calibration and intensity comparisons. Data are given for both the hexagonal and rhombohedral unit cell structures. (N.W.R.)

11590 THE LATTICE CONSTANTS OF THORIUM DIHYDRIDE. William L. Korst (Atomics International, Canoga Park, Calif.). Acta Cryst., 15: 287-8(Mar. 10, 1962).

Diffraction data are given for five samples of thorium hydride in the over-all composition range $ThH_{1.73}$ to $ThH_{1.98}$. The data given are for the face-centered tetragonal unit cell. The results show that the lattice constants vary with hydrogen content. The hydrogen content also affects the unit cell structure. (N.W.R.)

11591 INVESTIGATIONS CONCERNING THE RETENTION OF FISSION PRODUCTS ON HUMIC ACIDS. A. Szalay and M. Szilágyi (Inst. of Nuclear Research, Academy of Sciences, Debrecen, Hungary). Acta Phys. Acad. Sci. Hung., 13: 421-36(1961). (In English)

The retention of a number of fission products on humus-rich peat preparations was investigated. At a favorable pH (5–6) the following elements are firmly fixed: all rare earths and Y, Sr, Cs, and Zr isotopes. They are firmly fixed by cation exchange on peat with an enrichment constant (distribution coefficient) of about 10,000:1. Some fission products are certainly not fixed by humus, such as isotopes of iodine, Nb, not to mention the inert gases. The significance of this retention is dealth with, from the point of view of the treatment of fission product contaminated waste waters of the atomic industry and the circulation or retention of fission products carried down into the humus-rich fertile soil by atmospheric precipitation. (auth)

11592 METALLO-ORGANIC COMPOUNDS CONTAINING METAL–NITROGEN BONDS. PART II. SOME DIALKYLAMINO DERIVATIVES OF Nb(V) AND Nb(IV). D. C. Bradley and I. M. Thomas (Univ. of Western Ontario, London, Ont.). Can. J. Chem., 40: 449-54(Mar. 1962).

Reactions involving niobium pentachloride and lithium dialkylamides ($LiNR_2$, where R = Me, Et, Pr^n, Bu^n) led to considerable reduction of niobium to Nb(IV) as the length of the alkyl chains increased. $Nb(NMe_2)_5$ was isolated by sublimation but distillation of the other products gave tetrakis-(dialkylamino)-niobium(IV) compounds. Steric factors are apparently responsible for the low stability of pentakis-(dialkylamino)-niobium(V) compounds. The smaller steric effects of $-NMeBu^n$ and piperidino groups allowed the isolation of pentakis derivatives. The thermal decomposition of $Nb(NMeBu^n)_5$ gave mainly $Nb(NMeBu^n)_4$ with some $Bu^nN = Nb(NMeBu^n)_3$. Steric effects were also revealed in the replacement of $-NMe_2$ groups in $Nb(NMe_2)_5$ by $-NEt_2$ groups and in replacement of $-NEt_2$ groups in $Nb(NEt_2)_4$ by piperidino groups. (auth)

11593 OCCURRENCE OF LARGE NORMAL SECONDARY INTERMOLECULAR KINETIC ISOTOPE EFFECTS IN NON-EQUILIBRIUM SYSTEMS. B. S. Rabinovitch and J. H. Current (Univ. of Washington, Seattle and National Research Council, Ottawa). Can. J. Chem., 40: 557-9(Mar. 1962) (NRC-6669)

Discussion is given on the existence of large normal (besides inverse) secondary kinetic isotope effects in non-equilibrium systems produced by non-thermal methods of

activation. An equilibrium thermal unimolecular system in the RRKM formulation is considered. It is concluded that in general the $P^{+}_{\epsilon_v}$ ratio will not be unity and will partially compensate the density ratio, and the f(ϵ) functions may also have a compensatory character. The decomposition of chemically activated ethyl-d_x radicals provides an example of the new normal effect. (P.C.H.)

11594 THE REACTION OF A NITRILE WITH HEAVY WATER AND HYDROGEN DEUTERIDE. E. N. Zil'berman, A. Ya. Lazaris, G. G. Petukhov, O. D. Strizhakov, and V. I. Ganina (Gorkii State Univ., USSR). Doklady Akad. Nauk S.S.S.R., 142: 96-8(Jan. 1, 1962). (In Russian)

Dry DCl (0.02 to 0.03 moles), obtained by reacting NaCl with D_2SO_4, was passed into a mixture of 0.01 moles of a nitrile and 0.01 moles of D_2O. The mixture was allowed to stand for 24 hours at 0°C, and then was treated with D_2O until the chloride ion disappeared. The yield of amide was 42% for butyramide, 93% for adipamide, 60% for chloroacetamide, 78% for dichloroacetamide, 61% for trichloroacetamide, 80% for α,β-dichloropropionamide, 80% for β-chloropropionamide and 64% for benzamide. The intermediate addition product of DCl was isolated, and an infrared spectrum showed only the presence of N-D and O-D bonds, but not any C-D bonds. Exchange of a hydrogen atom attached to a carbon atom takes place only on hydrolysis of the intermediate addition compound. Thus, the deuterium content in deuterated β-chloropropionamide can be decreased from 2.2 atoms to 0.3 atoms by a double contact with excess H_2O. These reactions can be used to make tagged deuterium compounds. (TTT)

11595 REACTIVITY OF SATURATED HYDROCARBONS ON REACTION WITH FREE METHYL RADICALS IN A LIQUID. I. V. Berezin and O. Dobish (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 142: 105-8(Jan. 1, 1962). (In Russian)

Free methyl radicals react with a hydrocarbon as follows: $RH + CH_3^{*} \xrightarrow{k_1} R^{*} + CH_4$. The relative value of the reaction rate constant k_1 can be determined by comparing the above reaction rate with the reaction rate of the methyl radical with a standard hydrocarbon tagged with tritium. A series of experiments were run with mixtures of cyclohexane and heptane which were each tagged with tritium alternatively. Methyl radicals were generated by the thermal decomposition of acetyl peroxide (~0.05 moles/l) at 55 to 90°C. The tagged methane was counted in an internal gas counter. A plot of $\lg k_1(\text{hexane})/k_1(\text{cyclohexane})$ versus 1/T gave a straight line. These results showed that the value of the ratio of the reaction rate constants did not depend on the composition of the medium. Further experiments were run with the cis- and trans-decalines. Tagged cyclohexane and hexane were both used as standards in order to obtain reliable results. The reaction rate constant of cis-decalin with methyl radicals depends on the composition of the medium, especially when tagged heptane is used as the second component. The average reaction rate constant per bond is approximately the same at 80°C, but the activation energy varies widely and the reaction rates of the same hydrocarbons vary widely with temperature. Thus, a compensation effect is observed. It is assumed that the probability of activation does not depend on the average temperature of the medium, but on the local temperature in a small region. Thus, there is a close connection between the process of activation and the properties of the medium. Thus, if there are two competing reactions for one radical, one of these reactions can be suppressed by adding a third substance which does not react with the radicals but has a definite effect on the process of activation, as has been observed in systems containing aromatic compounds. (TTT)

11596 THE EFFECT OF THE PARTICLE SIZE OF GALENA ON THE ABSORPTION OF FLOTATION AGENTS. I. N. Plaksin and R. Sh. Shafeev. Doklady Akad. Nauk S.S.S.R., 142: 131-3(Jan. 1, 1962). (In Russian)

Various particle sizes of galena were contacted with a 1 g/l solution of potassium butyl xanthate tagged with S^{35} tracer. The particle size and concentration of xanthate were obtained at the same time by taking an autoradiograph of the particle on film and measuring the degree of blackening of the emulsion. The amount of xanthate adsorbed per unit surface of mineral decreased from 176 units for particles 150 to 175μ in size to 51 units for particles less than 5μ in size, as determined by measuring the degree of blackening with a MF-2 microphotometer. However, by counting the particles on an end-window counter it was found that the amount of xanthate per unit weight of galena increases with decreasing particle size due to an increase in the total surface of the particles. (TTT)

11597 THE SLOW STAGE IN THE OXIDATION REACTIONS CAUSED BY HYDROGEN ATOMS ACCORDING TO THE WEISS MECHANISM. V. G. Firsov and B. V. Ershler (Inst. of Experimental and Theoretical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 145-7 (Jan. 1, 1962). (In Russian)

The Weiss mechanism for the oxidation of Fe(II) solutions by H atoms assumes the following reactions: $H + H^{+} \rightarrow H_2^{+}$(4), and $Fe(II) + H_2^{+} \rightarrow Fe(III) + H_2$(5). The Fe(II) oxidation rate is determined by competition of reaction (4) and the reaction $H + H \rightarrow H_2$ for H atoms. In the presence of UO_2^{2+} the rate of oxidation of Fe(II) is determined by the competition of H^{+} and UO_2^{2+} for H atoms. Reaction (4) is the slow stage for the oxidation, since Fe(II) does not compete for H atoms, and the oxidation yield does not depend on the concentration of Fe(II) but does depend on pH and the concentration of UO_2^{2+} ion. The form of the oxidation curves should remain the same if UO_2^{2+} is replaced by U(IV) as an acceptor of H atoms according to the equation: $U(IV) + H \rightarrow U(III) + H^{+}$(6). Hence the oxidation yields of degassed sulfuric acid solutions of Fe(II) and U(IV) were determined as a function of pH and concentration of U(IV) after Co^{60} irradiation at a dose rate of 1.60×10^{19}ev/l-sec. The experimental values were found to agree well with the theoretical values if $k_4/k_6 = 1.25$ and reaction (4) is assumed to be the slow stage in the oxidation of Fe(II). It was found that Fe(II) could be replaced by U(III) as an acceptor for H_2^{+} ions. Thus, the oxidation yield of U(IV) solutions containing ~1% U(III) was 8.0 to 8.2 which is the same as the oxidation yield for a Fe(II) solution. This value of G does not change with increasing concentration of U(III). The value of k_4/k_6 for the U(III) + U(IV) solution was found to be 1.35 (compared to 1.25 for a Fe(II) solution). These results are in agreement with the Weiss mechanism with reaction (4) as the slow step in the oxidation process. (TTT)

11598 A STUDY OF THE ELEMENTARY REACTIONS INVOLVED IN THE REMOVAL OF A TRITIUM ATOM FROM PENTATRIACONTANE-18T BY FREE CYCLOHEXYL AND HEPTYL RADICALS IN THE LIQUID PHASE. I. V. Berezin and Ch'u Kuo (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 142: 383-6(Jan. 11, 1962). (In Russian)

Methyl radicals were formed by the thermal decomposition of acetyl peroxide (6.2×10^{-2} to 6.2×10^{-3}mol/l). Heptyl and cyclohexyl radicals were formed by reaction of the methyl radicals with heptane and cyclohexane. The rate of formation of heptyl or cyclohexyl radicals is obtained by determining the amount of methane formed in the following reaction: $C_7H_{16} + CH_3^{*} \rightarrow C_7H_{15}^{*} + CH_4$. The rate of recombination of the cyclohexyl and heptyl radicals was followed

by adding a small amount of pentatriacontane (PTA) tagged with tritium in position 18 (0.02% $C_{35}H_{71}T$). After completion of the reaction, the heptane or cyclohexane was separated from the PTA by distillation, and the activity was determined by counting. The activity in the residue was also counted. The activation energy for the recombination reaction was found to be 14,000 cal/mole for heptyl radicals and 13,000 cal/mole for the cyclohexyl radicals. (TTT)

11599 MEASURING THE FILM FORMING POTENTIALS OF LIQUIDS. Paul R. Benson and William R. Martini (Atomics International, Canoga Park, Calif.). Ind. Eng. Chem., Prod. Research and Develop., 1: 7-10 (Mar. 1962).

A test was required to measure the relative fouling potentials of organic coolants used in the Organic Moderated Reactor Experiment (OMRE). A simple pyrolytic fouling appratus was built employing an electrically heated, vertical cylinder in a capsule containing the liquid under test. The weight of film deposited under specific test conditions establishes the fouling potential of a coolant. Film weights between <1 and 200 mg were obtained from 240-g coolant samples. Reproducibility of results was within ±25%. The test is employed to evaluate the efficiency of processes designed to reduce fouling in organic reactor coolants. Tests have shown that processes which remove particles and high molecular weight organic components reduce the fouling potential of an organic reactor coolant. (auth)

11600 HEAT CAPACITIES AND THERMODYNAMIC FUNCTIONS OF IRON DISULFIDE (PYRITE), IRON DISELENIDE, AND NICKEL DISELENIDE FROM 5 TO 350°K. THE ESTIMATION OF STANDARD ENTROPIES OF TRANSITION METAL CHALCOGENIDES. Fredrik Groenvold and Edgar F. Westrum, Jr. (Univ. of Michigan, Ann Arbor). Inorg. Chem., 1: 36-48 (Feb. 1962).

The heat capacities at low temperatures of purified, natural pyrite and synthetic samples of $FeSe_2$ and $NiSe_2$ were determined by the adiabatic technique. The values of entropy and the free energy function, $-(F^0 - H_0^0)/T$ at 298.15°K in cal gfw^{-1} $°K^{-1}$ are, respectively: 12.65 and 4.926 for FeS_2; 20.75 and 9.74 for $FeSe_2$; 24.74 and 12.36 for $NiSe_2$. The estimation of the entropies of transition element chalcogenides is discussed. (auth)

11601 OBSERVATIONS ON THE RARE EARTHS. LXXIV. THE ENTHALPY AND ENTROPY OF FORMATION OF THE 1:1 AND 1:2 CHELATES OF NITRILOTRIACETIC ACID WITH TRIPOSITIVE CATIONS. Therald Moeller and Ricardo Ferrús (Univ. of Illinois, Urbana). Inorg. Chem., 1: 49-55 (Feb. 1962).

Enthalpy changes in the formation of 1:1 and 1:2 nitrilotriacetic acid (H_3NTA) chelates of the tripositive rare earth metal ions were evaluated by the temperature coefficient method for aqueous solutions of ionic strength 0.10 (KNO_3). Corresponding entropy changes were calculated from the enthalpy changes and stability constants at 25°. Values of enthalpy and entropy changes for the formation of $Ca(NTA)^-$ and $Cu(NTA)^-$ were obtained also. The importance of the configurational entropy in accounting for trends in the stabilities of the rare earth metal chelates again is apparent. (auth)

11602 OXYGEN TRACER EXPERIMENTS ON THE OXIDATION OF AQUEOUS URANIUM(IV) WITH OXYGEN-CONTAINING OXIDIZING AGENTS. Gilbert Gordon and Henry Taube (Univ. of Chicago and Univ. of Maryland, College Park). Inorg. Chem., 1: 69-75 (Feb. 1962).

Oxygen-18 tracer studies were made on the oxidation of aqueous uranium(IV) with various oxygen-containing oxidizing agents. The reactions studies were the oxidation of U^{+4}_{aq} by solutions of MnO_4^-, CrO_4^{3-}, H_2O_2, and some halogenates; solid samples of PbO_2, MnO_2, and $NaBiO_3$; and gaseous samples of O_2 and O_3. With oxygen or ozone only one of the oxygens in the UO_2^{2+} product derives from the oxidizing agent. In the case of PbO_2 or MnO_2 both (very nearly) oxygens in the UO_2^{2+} derive from the oxidizing agent. These results are interpreted in terms of oxygen atom transfer accompanied either by hydrolysis with solvent or by oxide ion transfer from the oxidizing agent. (auth)

11603 B_9H_9–DCl EXCHANGE CATALYZED BY $AlCl_3$. Thomas P. Onak and Robert E. Williams (Los Angeles State Coll. and National Science Co., Pasadena, Calif.). Inorg. Chem., 1: 106-8 (Feb. 1962).

Treatment of pentaborane-9 with deuterium chloride in the presence of aluminum chloride results in the rapid exchange of hydrogen and deuterium in the 1-position. 1-Deuteriopentaborane was identified by the B^{11} and H^1 nmr spectra and confirmed by the stoichiometry of the exchanging species at equilibrium. (auth)

11604 SYNTHESIS OF FLUOROMETALLATES IN METHANOL. SOME STRUCTURE RELATIONSHIPS. II. URANIUM AND GROUP V METALS. Ann E. Baker and Helmut M. Haendler (Univ. of New Hampshire, Durham). Inorg. Chem., 1: 127-33 (Feb. 1962).

The complexes $(NH_4)_3UO_2F_5$, $K_3UO_2F_5$, $(NH_4)_3VOF_5$, K_3VOF_5, $(NH_4)_3NbOF_6$, K_3NbOF_6, $(NH_4)_3TaOF_6$, and K_3TaOF_6 were prepared by bromination of the metal in methanol and subsequent precipitation of the fluorometallate by addition of the bromination solution to a solution of the alkali fluoride in methanol. A study of the bromination of uranium in methanol showed that the uranium bromides formed react with methanol to give hydrogen bromide, which further reacts with the metal, hydrogen being evolved. Cell constants of the complexes were determined from x-ray powder data and densities were measured. The uranium complexes were isostructural, as were the vanadium complexes. These complexes appear to be tetragonal and contain eight formula units per unit cell. The niobium and tantalum complexes were isostructural, were face-centered cubic, and contained four formula units per unit cell. Magnetic susceptibility measurements showed that the vanadium complexes contain one unpaired electron per vanadium atom. Infrared studies suggest hydrogen bonding in $(NH_4)_3UO_2F_5$. (auth)

11605 PREPARATION AND PROPERTIES OF AQUEOUS TETRAVALENT AMERICIUM. L. B. Asprey and R. A. Penneman (Los Alamos Scientific Lab., N. Mex.). Inorg. Chem., 1: 134-6 (Feb. 1962).

Stable aqueous solutions of tetravalent americium were prepared readily by reaction of $Am(OH)_4$ with saturated ammonium fluoride. Heating to 90° did not cause disproportionation of Am(IV) nor its chemical reduction by water. Slow reduction of Am(IV) to Am(III) occurred due to Am^{241} alpha radiation. At 25°, the solubility of Am(IV) in 13M NH_4F was 0.02M and the solid phase in equilibrium was $(NH_4)_4AmF_8$. Concentrated solutions of KF, RbF, and CsF also reacted with $Am(OH)_4$ yielding sparingly soluble Am(IV)-fluoride complexes. In 13M NH_4F, 0.02M Am(IV) has a rose color and a characteristic absorption spectrum which is different from those of Am(III), Am(V), and Am(VI). The narrow Am(IV) peak at 4560 Å. (ϵ = 30) is separated from peaks of other americium valence states and can be used to determine Am(IV) quantitatively. Iodide ion reduces Am(IV) to Am(III). Ozone oxidizes Am(IV) in 13M NH_4F to Am(VI). (auth)

11606 A CRYSTALLINE FLUORIDE COMPLEX OF TETRAVALENT AMERICIUM. F. H. Kruse and L. B. Asprey (Los Alamos Scientific Lab., N. Mex.). Inorg. Chem., 1: 137-9(Feb. 1962).

A stable crystalline complex of tetravalent americium, Rb_2AmF_6, was obtained from an aqueous fluoride solution. It is isostructural with the analogous compound of tetravalent uranium, Rb_2UF_6. Complex fluorides of tetravalent americium prepared from aqueous solution hitherto were unknown. Both compounds are orthorhombic, probable space group $Cmc2_1$, four molecules per unit cell, dimensions: Rb_2AmF_6: $a_0 = 6.98$, $b_0 = 12.09$, $c_0 = 7.56$ Å.; Rb_2UF_6: $a_0 = 6.958$, $b_0 = 12.042$, $c_0 = 7.605$ Å. The crystallographic relation between these orthorhombic compounds and previously known hexagonal fluoride complexes having the same stoichiometry is described. (auth)

11607 ION-EXCHANGE STUDIES OF THE LANTHANIDES AND ACTINIDES IN CONCENTRATED MINERAL ACIDS. Gregory R. Choppin and Robert H. Dinius (Florida State Univ., Tallahassee). Inorg. Chem., 1: 140-5(Feb. 1962).

The absorption of trivalent lanthanide and actinide ions by Dowex-50 ion-exchange resin was studied in concentrated solutions of perchloric, hydrochloric, hydrobromic, and hydriodic acids. An explanation of the very strong absorption in 12M $HClO_4$ is offered in terms of extraction of metal ion-perchlorate ion-pairs into the resin phase. The order of complexing, $Cl > Br > I > ClO_4$, agreed with the normal order for covalent complexes. (auth)

11608 COMPOUNDS EXHIBITING COÖRDINATION NUMBER EIGHT: THE POTASSIUM TETRAOXALATOMETALLATES OF ZIRCONIUM(IV), HAFNIUM(IV), THORIUM(IV), AND URANIUM(IV). Frederic A. Johnson and Edwin M. Larsen (Univ. of Wisconsin, Madison). Inorg. Chem., 1: 159-65(Feb. 1962).

Conditions for the preparation of the tetraoxalatometallates of zirconium(IV), hafnium(IV), thorium(IV), and uranium(IV), free of hydrolysis products, were studied. The zirconium and hafnium compounds are monoclinic with four molecules in the unit cell. The crystals belong to the space group $P2_1/a$, which permits the existence of mirror images in the solid state. Attempts to resolve the possible racemic pairs of these anions were unsuccessful. Oxalate exchange studies with C^{14} containing oxalic acid showed that complete exchange occurred within a few minutes time of the experiment. It is shown that the anions lose oxalate by hydrolysis and/or aquation. The infrared spectra have frequencies for O–C–O vibrations about half way between those for the oxalate ion and a covalent oxalate molecule. (auth)

11609 THERMOCHEMISTRY OF INNER COMPLEX SALTS: SOME HEATS OF COMBUSTION AND BOND ENERGIES. Mark M. Jones, Billy J. Yow, and Walter R. May (Vanderbilt Univ., Nashville). Inorg. Chem., 1: 166-9 (Feb. 1962).

The heats of combustion of the acetylacetonates of Fe(III), Cr(III), Co(III), Th(IV), Cu(II), Mg(II), UO^{2+}, and UO_2^{2+} and three complexes of Cu(II) with amino acids were measured with a bomb calorimeter. By using a thermochemical cycle in which all the terms but one are experimentally accessible, values of the coördinate bond energies in these complexes may be calculated. For acetylacetonates of the type $M(C_5H_7O_2)_3$, where M is Cr, Fe, and Co, the heats evolved on formation of the complexes in the gas phase from ligand and metal atom show a minimum at Fe as expected from crystal field effects. (auth)

11610 SOME METAL CHELATES OF ETHYLENEDIAMINETETRAACETIC ACID, DIETHYLENETRIAMINEPENTAACETIC ACID, AND TRIETHYLENETETRAMINEHEXAACETIC ACID. Robert E. Sievers and John C. Bailar, Jr. (Univ. of Illinois, Urbana). Inorg. Chem., 1: 174-82(Feb. 1962).

The properties and structural characteristics of some metal chelates of ethylenediaminetetraacetic acid, diethylenetriaminepentaacetic acid, and triethylenetetraminehexaacetic acid are reported. For chelates of 33 different metal ions, a correlation is observed between the charge/size ratio of the metal ion and the degree of covalency in the metal–oxygen bond. The infrared spectra of chelates of metal ions having charge/size ratios larger than 3.6 exhibit carbonyl absorption maxima in the 1625 to 1650 cm^{-1} region, but in complexes were the ratio is below 3.6 the maxima occur between 1590 and 1615 cm^{-1}. A Th(IV) complex, in which diethylenetriaminepentaacetic acid apparently functions as an octodentate ligand, was isolated. Syntheses of binuclear Mo(V) complexes of diethylenetriaminepentaacetic acid and triethylenetetraminehexaacetic acids are reported. (auth)

11611 LUMINESCENCE OF GADOLINIUM SALTS. A. N. Zaidel, G. S. Lazeeva, G. V. Ostrovskaya, and P. P. Yakimova (Leningrad State Univ. and Ioffe Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 74-80(Jan. 1962). (In Russian)

Luminescence spectra of Gd ions were studied, and the nature of its luminescence band was investigated at room and liquid air temperatures with chlorides ($GdCl_6 \cdot 6H_2O$ and 0.1 to 1% $CdCl_3$ aqueous solutions); sulfates ($Gd_2(SO_4)_3 \cdot 6H_2O$, anhydrous $Gd_2(SO_4)_3$, and aqueous and sulfuric acid solutions of $Gd_2(SO_4)_3$); and ethylsulfates [$Gd(C_2H_5SO_4)_3$]. (R.V.J.)

11612 THE INFLUENCE OF RARE EARTH IONS ON IODINE ABSORPTION SPECTRA IN AQUEOUS SOLUTION. V. V. Serebrennikov and I. P. Gorelov (Tomsk Univ., USSR). Izvest. Vysshikh Ucheb. Zavedenil, Fiz., No. 4: 175-6(1961). (In Russian)

The influence of rare earth ions on the absorption spectrum of iodine in aqueous solution was studied. A shift at 4000 to 6000 Å to the short wave region was observed during the formation of rare earth polyiodides. The rare earth polyiodides are of $Me(I_3)_3$ composition. (R.V.J.)

11613 THERMODYNAMICS OF ION HYDRATION AS A MEASURE OF EFFECTIVE DIELECTRIC PROPERTIES OF WATER. Richard M. Noyes (Univ. of Oregon, Eugene). J. Am. Chem. Soc., 84: 513-22(Feb. 20, 1962).

An improved method was developed for evaluating the changes in thermodynamic properties associated with hydration of individual species of gaseous monatomic ions. Application of the method to entropy data leads to consistent results only by neglecting the contributions observed during solvation of neutral atoms of the same size. The partial molal entropy of hydrogen ion at 25° is estimated to be −3.3 cal/mole deg in satisfactory agreement with thermocell calculations. For cations having the electronic structure of an inert gas, the free energies of hydration indicate effective dielectric constants that depend only on size of ion and are virtually independent of charge. These effective dielectric constants can be used to estimate local dielectric constant as a function of distance from the center of a cation, but the data are not sensitive enough to permit extrapolation beyond the radius of the largest cation studied. Cations not having an inert gas structure show larger absolute enthalpies and free energies of hydration as predicted

by ligand field theory. The singly charged d^{10} ions Cu^+, Ag^+, and Au^+ exhibit extreme solvation effects that are not observed for any other ions, including the isoelectronic species Zn^{2+}, Cd^{2+}, and Hg^{2+}. Thermodynamic properties change more during the hydration of anions than for cations of the same size, and the few available data do not exhibit the monatonic variation with ionic size that is observed with cations. (auth)

11614 DEUTERIUM ISOTOPE AND SOLVENT EFFECTS ON THE KINETICS OF THE KETO-ENOL INTERCONVERSION OF 2-ACETYLCYCLOHEXANONE. T. Riley and F. A. Long (Cornell Univ., Ithaca, N. Y.). J. Am. Chem. Soc., 84: 522-6(Feb. 20, 1962).

The rate of enolization of 2-acetylcyclohexanone, as measured by its rate of bromination, exhibits general base catalysis (only) with a Brönsted β of 0.60. The datum for water as a base fits well with the data for other bases. The relative reactivity of the 2-monodeuterated ketone leads to a kinetic isotope effect of $k_{KH}/k_{KD} \simeq 5$ for reaction of the ketones with either of the catalysts water or acetate ion. For reactions of the ordinary ketone in the solvents H_2O and D_2O, $(k_{KD}{}^H/k_{KH}{}^D)_{OAc^-} = 1.2$, and $(k_{KH}{}^H/k_{KH}{}^D)_{water} = 1.4$, leading to the conclusion that the base strengths of the species H_2O and D_2O are in the ratio 1.2, and are not significantly different. Measurements of the keto–enol equilibrium and of the acid strength of the enol in the solvents H_2O and D_2O permit calculation of the relative rates of the reverse reactions. For the over-all ketonization, the relative rates k_H/k_D are again about 5 for the various catalysts. For the slow step, the attack of acid on the enolate ion, the ratios are $(k_E{}^H/k_E{}^D)_{H_3O^+} = 1.7$ and $(k_E{}^H/k_E{}^D)_{HOAc} = 5.9$. Both ratios are close to those for methyl acetylacetone, and it is concluded that the solvated proton is only about 1.5 times a better acid than is the solvated deuteron. Finally, these data, along with similar results for hydroxide ion, lead to the conclusion that H_2O is about a 5-fold stronger acid than is D_2O. (auth)

11615 THE ENERGY DEPENDENCE FOR REACTION CROSS SECTIONS OF ION-MOLECULE REACTIONS OF CYCLOPROPANE IN THE MASS SPECTROMETER. Roswell F. Pottie, Andrée J. Lorquet, and William H. Hamill (Univ. of Notre Dame, Ind.). J. Am. Chem. Soc., 84: 529-31(Feb. 20, 1962).

Appearance potentials of the important primary ions, and of 14 secondary ions, were measured for cyclopropane. The dependence of secondary ion reaction cross sections upon ion velocity show discontinuities which can be described by analytical expressions allowing for head-on collisions and upper energy limits of secondary ion stability. (auth)

11616 DEUTERIUM OXIDE SOLVENT ISOTOPE EFFECTS IN THE NUCLEOPHILIC REACTIONS OF PHENYL ESTERS. Myron L. Bender, Edward J. Pollock, and Maurice C. Neveu (Illinois Inst. of Tech., Chicago and Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc., 84: 595-9(Feb. 20, 1962).

Deuterium oxide solvent isotope effects in two intramolecular and three intermolecular nucleophile-catalyzed hydrolyses of phenyl esters were determined. Reactions utilizing carboxylate ion as a nucleophile resulted in ratios of k^{H_2O}/k^{D_2O} of 1.8 while reactions utilizing a tertiary amine as a nucleophile gave ratios of 0.9 to 1.0. Values of the isotope effect in the carboxylate ion reactions calculated on the basis of the consideration of the secondary deuterium isotope effects were 1.5 to 1.6 in reasonable agreement with the experimental values. A comparison is made of kinetic isotope effects in general base- and nucleophile-catalyzed hydrolyses, reflecting primary and secondary deuterium isotope effects, respectively. While there is ambiguity in distinguishing between these isotope effects, they may be used in certain restricted situations as an empirical criterion in distinguishing between general base- and nucleophile-catalyzed hydrolyses. (auth)

11617 INITIAL-STATE AND TRANSITION-STATE ISOTOPE EFFECTS OF METHYL HALIDES IN LIGHT AND HEAVY WATER. C. Gardner Swain and Edward R. Thornton (Massachusetts Inst. of Tech., Cambridge). J. Am. Chem. Soc., 84: 822-6(Mar. 5, 1962).

Solubilities of four methyl halides at 29.4° and 40.3° are nearly the same in H_2O as in D_2O. Evidently these solutes fit into holes in the water, without either freeing or restricting the motion of surrounding water molecules. Since initial-state isotope effects are so small, calculated transition-state isotope effects for hydrolysis are nearly equal to the observed kinetic isotope effects. Methyl chloride is more ionized than methyl bromide at the transition state in solvolysis in water at 40–70°. (auth)

11618 OXYGEN-17 NMR SHIFTS IN AQUEOUS SOLUTIONS OF RARE-EARTH IONS. W. Burton Lewis, Jasper A. Jackson, Joe Fred Lemons, and Henry Taube (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 36: 694-701(Feb. 1, 1962).

Paramagnetic and diamagnetic shifts of the O^{17} NMR signal in aqueous solutions of the rare earth ions at room temperature were observed. The shift arises from the isotropic part of the hyperfine interaction between the O^{17} nucleus and the thermal average value of the spin of the rare earth ion. The direction of the shift is in all cases opposed to the spin magnetization of the rare earth ion. This result is explained through the formation of covalent bonds in the hydrated ion involving the rare earth 6s orbital. (auth)

11619 ROLE OF f-ORBITAL ELECTRON WAVE FUNCTION MIXING IN THE CONCENTRATION QUENCHING OF Eu^{3+}. L. G. Van Uitert, R. C. Linares, R. R. Soden, and A. A. Ballman (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 36: 702-5(Feb. 1, 1962).

The dependencies of intensity of emission of Eu^{3+} upon its concentration were examined for several oxide systems which differ in structural arrangements and cation charge type. The data show that concentration quenching increases with the rise of perturbing influences which probably result from the mixing of the *f*-orbital wave functions of different Eu^{3+} ions through a lattice band process. (auth)

11620 NUCLEAR MAGNETIC RESONANCE STUDY OF THE DIFFUSION OF HYDROGEN IN ZIRCONIUM HYDRIDE. J. F. Hon (Atomics International, Canoga Park, Calif.). J. Chem. Phys., 36: 759-63(Feb. 1, 1962).

Diffusion of hydrogen in two hydrides of zirconium, $ZrH_{1.54}$ and $ZrH_{1.99}$, was studied by nuclear magnetic resonance methods. The activation energy for diffusion of hydrogen by a direct tetrahedral to tetrahedral site jump mechanism was found to be 0.54 ev in both compositions. A complex proton line shape was observed in $ZrH_{1.99}$ over part of the temperature range covered in these measurements. A tentative explanation of this line shape results in an estimate of 0.65 ev for the activation energy for diffusion by an indirect tetrahedral to octahedral to tetrahedral site mechanism. The rigid lattice linewidth of the proton line in both hydrides was found to be too large to be accounted for by nuclear dipolar broadening. (auth)

11621 ELECTRON-OPTICAL PHONON INTERACTION FOR PARAMAGNETIC IONS IN CRYSTALLINE FIELDS. S. A. Pollack and R. A. Satten (Univ. of California, Los Angeles). J. Chem. Phys., 36: 804-16(Feb. 1, 1962).

The theory of vibronic transitions in rare earth and actinide series crystalline salts is applied to ions and ion complexes interacting with the vibrational modes of the entire crystal. Selection rules and expected fine structure are presented making use of space group representation theory. The results are applied to the visible spectra of three U^{4+} ion crystalline salts which are analyzed in higher dispersion than in previous work, and including $[N(C_2H_5)_4]_2UCl_6$. The similarity of the absorption bands associated with each electronic level provides additional evidence for the vibronic nature of the spectrum. Electronic level positions given earlier are confirmed. The broad features of the spectrum such as the strongest vibronic bands can be described in terms of the vibronic states of a single ion complex. These bands, however, have structure at 77°K in thin crystals and a finer structure more evident at 4.2°K, which is explained for some levels as due to the splitting of the vibrational optical branches when the wave vector k is nonzero, and for other levels the latter in combination with a splitting of vibronic bands resulting from electron-vibration interaction. The electron-vibration interaction applied to a single ion complex does not lead to structure in a vibronic spectral line. It is experimentally demonstrated that pure electronic electric dipole transitions forbidden to appear when the U^{4+} ion is at a center of inversion symmetry can appear due to the presence of impurities which destroy the inversion symmetry. The splitting of some of the pure electronic levels expected as one goes from O_h to D_{3d} to D_{2h} symmetry seems not to occur except possibly in one or two cases. More precise temperature shift measurements are presented. The possible existence of some metastable optical branches at 4.2°K is indicated. (auth)

11622 SELECTIVE EXCITATION OF TRIVALENT THULIUM VIA INTRAMOLECULAR ENERGY TRANSFER. G. A. Crosby and R. E. Whan (Univ. of New Mexico, Albuquerque). J. Chem. Phys., 36: 863-5(Feb. 15, 1962).

The results of luminescence studies of thulium trisbenzoylacetonate and thulium trisdibenzoylmethide are reported. Selective excitation of the $^1G_4$ level of Tm^{3+} via energy transfer was achieved. Emission from the $^3F_4$ level of the ion was observed, and all the groups of lines appearing in the visible and near infrared spectral regions were assigned. A quenching mechanism involving vibrational coupling of the ion with the ligand is discussed. Ligand field splitting is reported. (auth)

11623 HEAT CAPACITIES AND THERMODYNAMIC FUNCTIONS OF YH_2 AND YD_2 FROM 5° TO 350°K AND THE HYDROGEN VIBRATION FREQUENCIES. Howard E. Flotow, Darrell W. Osborne, and Klaus Otto (Argonne National Lab., Ill.). J. Chem. Phys., 36: 866-72(Feb. 15, 1962).

The heat capacities of pure YH_2 and YD_2 were measured by an adiabatic method from 5 to 350°K. The compounds were found by x-ray analyses to consist of a single phase, with the yttrium atoms in face-centered cubic positions. Below 16°K the heat capacities of the two compounds are equal within experimental error, between 16 and 90°K the heat capacity of the hydride is about 0.02 cal deg^{-1} $mole^{-1}$ greater than that of the deuteride, and at higher temperatures that of the deuteride becomes appreciably greater. The difference in the heat capacities above 100°K is ascribed to a single optical vibration of the hydrogen atoms, whose frequency is shifted upon isotopic substitution. The difference in the heat capacities of YH_2 and YD_2 in the temperature range 100 to 350°K is fitted to ±0.02 cal deg^{-1} $mole^{-1}$ with Einstein heat capacity functions and a frequency of 1030 ± 30 cm^{-1} for YH_2 and $1030/\sqrt{2}$ for YD_2. These results are compared with those obtained by inelastic neutron scattering experiments. The values obtained for the heat capacity, entropy, enthalpy, and Gibbs free-energy function for YH_2 at 298.15°K are 8.243 ± 0.016 cal deg^{-1} $mole^{-1}$, 9.175 ± 0.018 cal deg^{-1} $mole^{-1}$, 1403 ± 3 cal $mole^{-1}$, and −4.470 ± 0.009 cal deg^{-1} $mole^{-1}$, respectively. The corresponding values for YD_2 are 10.773 ± 0.022, 10.294 ± 0.021, 1659 ± 3, and −4.729 ± 0.010. The enthalpy of formation of YH_2 minus the enthalpy of formation of YD_2 is calculated to be 0.78 ± 0.08 kcal $mole^{-1}$ at 0°K and 0.55 ± 0.08 kcal $mole^{-1}$ at 298.15°K. (auth)

11624 DEUTERON QUADRUPOLE COUPLING IN DIATOMIC "HYDRIDES." H. J. Kolker and M. Karplus (Columbia Univ., New York). J. Chem. Phys., 36: 960-5 (Feb. 15, 1962).

For LiD and DF, the deuteron quadrupole coupling constant (eqQ/h) was calculated with single-determinant SCF-LCAO-MO functions. The results obtained are 38 kc/sec for LiD and 373 kc/sec for DF, in rather satisfactory agreement with the recently measured values (30 ± 3 kc/sec for LiD and 340 ± 40 kc/sec for DF). To evaluate the molecular integrals required for the determination of q, a formulation in terms of confocal elliptic coordinates was used. This made possible the introduction of certain auxiliary functions that are very convenient for the calculation of field gradient and related integrals. A comparison of the quadrupole coupling constants obtained with a number of different molecular orbital functions is presented. The results demonstrate the importance of using atomic basis functions with exponents optimized for the molecular system and suggest that exact Hartree-Fock functions may yield relatively reliable values for field gradients and other one-electron weak-interaction parameters. A calculation of the field gradient at the Li nucleus (q = −0.0401 amu) yields a value of -3.7×10^{-26} cm^2 for the Li^7 quadrupole moment when combined with the coupling constant measurement of +346 ± 1 kc/sec. (auth)

11625 DISSOCIATION OF GASEOUS DIATOMIC MOLECULES: CLASSICAL ADIABATIC SCATTERING APPROACH. John C. Light (Université Libre, Brussels). J. Chem. Phys., 36: 1016-30(Feb. 15, 1962).

The classical Liouville equation of a three-body system consisting of a harmonic oscillator and a free particle is resolved by an adiabatic approximation procedure based on the assumption that the collision time is much larger than the period of vibration of the oscillator. An integral formalism developed from the Liouville equation is used, and strong interactions can be treated. Numerical calculations of the rate of dissociation of homonuclear diatomic molecules are in good agreement with experimental results over large temperature ranges. The Lennard-Jones 6-12 potential is used, and comparisons between one and three-dimensional calculations are made. (auth)

11626 DIFFUSION OF HYDROGEN AND DEUTERIUM IN FUSED QUARTZ. R. W. Lee, R. C. Frank, and D. E. Swets (General Motors Corp., Warren, Mich.). J. Chem. Phys., 36: 1062-71(Feb. 15, 1962).

A mass spectrometer was used to record the transfer of hydrogen and deuterium through hollow, thin-walled cylinders of fused quartz over the temperature range of 300 to 1000°C. Steady-state gas permeation measurements resulted in permeability values which agree well with the literature; however, results of transient experiments which provide a direct means of measuring diffusion coefficients did not agree with so-called normal diffusion. The deviation from normal diffusion increases with increasing tempera-

ture. Measurements were made of the temperature variation in the rate of release of deuterium from fused quartz resulting from replacement by dissolved hydrogen. A chemical exchange between the diffusing molecules (H_2 or D_2) and one or more species of trapped gas within the fused quartz is thought to be the principal cause of the nondiffusion-like character of the high-temperature gas transport. Activation energies were calculated for the permeability (H_2: 8.88 kcal/mole, D_2: 9.05 kcal/mole), diffusion (H_2: 10.37 kcal/mole, D_2: 10.52 kcal/mole), and chemical exchange (15.5 kcal mole) mechanisms. Experimental solubilities were compared with the so-called normal solubilities (S_n = permeability/diffusion coefficient) and were found to exceed the normal to a greater extent with increasing temperature. (auth)

11627 CHEMICAL SHIFT OF THE Pb^{207} NMR IN SOME POLAR SEMICONDUCTORS. I. Weinberg (Ford Motor Co., Newport Beach, Calif.). J. Chem. Phys., 36: 1112-13 (Feb. 15, 1962).

Data obtained on chemical shifts of Pb^{207} in PbTe, PbS, and PbSe polar semiconductors and $Pb(NO_3)_2$ indicate that a major portion of the paramagnetic chemical shift is attributable to the effects of covalency. This tends to support conclusions reached with regard to the generally covalent character of the semiconducting bond. (P.C.H.)

11628 HEAT OF FORMATION OF DEUTERATED DIBORANE. Stuart R. Gunn and LeRoy G. Green (Univ. of California, Livermore). J. Chem. Phys., 36: 1118 (Feb. 15, 1962).

The head of decomposition of B_2D_6 was measured by explosion in mixtures with stibine. ΔH_{298} for the reaction $2B_{(g)} + 6H_{(g)} = B_2H_{6(g)}$ was obtained as B_2H_6, −575.44, and B_2H_6, −585.29. The results indicate that the potential energy functions of the isotopic molecules are very similar. The heats of decomposition of B_2D_6 are tabulated. (P.C.H.)

11629 THE HALIDES OF NIOBIUM AND TANTALUM. PART VI. Fred Fairbrother and John F. Nixon (The University, Manchester, Eng.). J. Chem. Soc., 150-6(Jan. 1962).

Complex formation between dimethyl sulfide, diethyl sulfide, and tetrahydrothiophen and niobium pentachloride and pentabromide, and tantalum pentachloride, pentabromide, and pentaiodide was studied. The following crystalline 1:1 complexes were isolated, and their compositions established by analysis and vapor pressure measurements: $NbCl_5,Me_2S$; $NbBr_5,Me_2S$; $TaCl_5,Me_2S$; $TaBr_5,Me_2S$ (mp 108°); $NbCl_5,Et_2S$ (mp ~17°); $TaCl_5,Et_2S$ (liquid)—all of which distilled or sublimed unchanged—and $NbBr_5,Et_2S$, $TaBr_5,Et_2S$, and TaI_5,Et_2S which decomposed on heating into their original components. There was also some evidence for $TaCl_5,2Me_2S$, melting incongruently at about 15°. The halides are more soluble in the sulfides than in diethyl ether, and the complexes more stable. There is very little splitting of the sulfide on heating. Tetrahydrothiophen formed 1:2 complexes: $NbCl_5,2[CH_2]_4S$, $NbBr_5,2[CH_2]_4S$, $TaCl_5,2[CH_2]_4S$, $TaBr_5,2[CH_2]_4S$, and $TaI_5,2[CH_2]_4S$. Except for $TaI_5,2[CH_2]_4S$ these were insoluble in tetrahydrothiophen. (auth)

11630 COMPOSITION AND SOLUBILITY OF CERIUM(III) CHLORIDE ALCOHOLATES. F. R. Hartley and A. W. Wylie (Chemical Research Labs., C.S.I.R.O., Melbourne). J. Chem. Soc., 679-81(Feb. 1962).

Methyl alcoholates of cerium chloride were investigated by determining the vapor pressure-composition isotherm at 21.3 ± 0.1°. Four equilibrium stages, and a possible fifth, were recognized: at 72.5 mm, corresponding to the saturated solution; at 71.0 mm, a slight flattening of the curve, which may indicate a labile tetra-alcoholate; at 45.5 mm, corresponding to the tri-alcoholate; at 19.2 mm, corresponding to the dialcoholate; and at 0.5 mm, corresponding to the monoalcoholate. Thus cerium chloride may combine, according to circumstances, with from one to four molecules of aliphatic alcohol. (P.C.H.)

11631 PARTICLE SIZE NONUNIFORMITY IN LARGE SCALE COLUMNS. J. Calvin Giddings and Edward N. Fuller Fuller (Univ. of Utah, Salt Lake City). J. Chromatog., 7: 255-8(Feb. 1962). (In English)

Experiments were made on particle size distribution in a packed tube, which has an important effect on the potential efficiency of large columns. Results obtained with 80/100 mesh chromosorb W and 120/170 mesh glass beads show that, irrespective of mechanism, larger particles tend to accumulate at the outside and therefore greater velocities are expected at the outside. It was concluded that particle size variation can easily explain full velocity variation, but that the wall effect can only account for a small fraction, if any, of the variation. Particle size variation, however, cannot be ignored. (P.C.H.)

11632 THE TEMPERATURE RANGE OF LIQUID METALS AND AN ESTIMATE OF THEIR CRITICAL CONSTANTS. A. V. Grosse (Temple Univ., Philadelphia). J. Inorg. & Nuclear Chem., 22: 23-31(Dec. 1961).

The temperature range of liquid metals is shown to extend, in the case of the refractory metals, tungsten, tantalum, and rhenium, to over 20000°K. Methods are described that show how, based on the law of rectilinear diameter, and available experimental data, such as density vs temperature, and vapor pressures, heats and entropies of vaporization, liquid temperature diagrams for various metals, may be constructed. Estimates for the critical temperature, pressure, and density of various metals, for example, sodium, lead, and tin, were made. (auth)

11633 THERMAL DECOMPOSITION OF THE LIGHT RARE EARTH OXALATES. A. Glasner and M. Steinberg (Hebrew Univ., Jersualem). J. Inorg. & Nuclear Chem., 22: 39-48(Dec. 1961).

The thermal decomposition of the light rare earth oxalates was studied in vacuum in the temperature range 340–440°C. The behavior of the whole group (with the exception of europium oxalate) was analogous to that of lanthanum oxalate. The relative order of stability, as well as that of the intermediate normal and basic carbonates, is: Gd > Sm > Nd > La > Pr > Ce. The carbon monoxide, initially formed by the decomposition of the oxalates, underwent disproportionation. The degree of disproportionation was highest in the case of cerous oxalate (72%), and lowest in the case of gadolinium oxalate (58%), decreasing in reverse of the order of stability, with lanthanum and praseodymium changing places. (auth)

11634 THE REDUCTION OF ZIRCONIUM(IV) IODIDE. G. W. Watt and W. A. Baker, Jr. (Univ. of Texas, Austin). J. Inorg. & Nuclear Chem., 22: 49-54(Dec. 1961).

The reduction of ZrI_4 with Al to ZrI_3 in high yields and high purity under conditions that essentially eliminate product contamination with Al is described; limited evidence for reduction to ZrI_2 is included. Similar reduction with other metals that form volatile iodides (Fe, Ge, Hg) is also described. The reduction of ZrI_4 to Zr or conversion of ZrI_4 to ZrO_2 in electrodeless discharges in different gaseous atmospheres is described and the results are compared with those from related work. (auth)

11635 COMPLEXES OF THE LANTHANIDE ELEMENTS WITH α-HYDROXY CARBOXYLATE LIGANDS.

G. R. Choppin and J. A. Chopoorian (Florida State Univ., Tallahassee). J. Inorg. & Nuclear Chem., 22: 97-113 (Dec. 1961).

Successive formation constants were determined for the α-hydroxy-isobutyrate, lactate, and glycolate complexes of nine lanthanide elements and yttrium by potentiometric titration. The formation constants increase as a function of atomic number for each ligand system with some irregularity in the trend in the Sm–Eu–Gd region. For a given lanthanide the order of complex stability is α-hydroxy isobutyrate > lactate > glycolate. This order and the values of ΔH and ΔS for the formation of the monocomplex of Ce(III) and Gd(III) indicate that the relative order of complex stability is governed by an inductive effect of the ligand. For all the metal ions, including Y(III), the average ligand number exceeds a value of three indicating the formation of the complex ML_4^- (M = trivalent metal ion, L = organic ligand). (auth)

11636 AQUEOUS SYSTEMS AT HIGH TEMPERATURE. III. INVESTIGATIONS ON THE SYSTEM UO_3–CuO–NiO–SO_3–H_2O AT 300°C. William L. Marshall and James S. Gill (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 22: 115-32(Dec. 1961).

Solubility relationships at 300°C in the five-component system UO_3–CuO–NiO–SO_3–H_2O, and its included aqueous four- and three-component systems, were investigated. Also reported are a few data on the analogous D_2O system. In order to gain over-all information in a relatively short period of time, the experimental program consisted in determining ternary L + S, quaternary L + 2S, and quinary L + 3S curves at constant temperature for which, by definition, one, two, and three solid phases, respectively, were in equilibrium with a liquid phase. For any set of experiments containing the same solid phases the SO_3 concentration was varied in order to give a solubility curve as a function of this variable. Accordingly, skeletal solubility data, obtained for the five-component system and its accessory four- and three-component systems, gave an over-all description of the solubility equilibria at 300° in the condensed system. Comments are made regarding the nature of the species in solution, the general shape of some of the solubility curves, the correlation of solid-liquid with liquid-liquid equilibria, and a specific application to aqueous homogeneous reactor fuels. (auth)

11637 ANION EXCHANGE OF METAL COMPLEXES. VII. THE LANTHANIDES–NITRATE SYSTEM. Y. Marcus and I. Abrahamer (Israel Atomic Energy Commission Labs., Rehovoth). J. Inorg. & Nuclear Chem., 22: 141-50(Dec. 1961).

Previous results for the distribution of the lighter lanthanides between nitrate solutions and a strongly basic anion exchanger are extended by data for the heavier lanthanides. An odd-even Z effect, previously observed in solvent extraction studies, was also found. The extraction of the lanthanides by a long chain amine is described briefly. The results are interpreted in terms of nitrate complex formation and changes in the hydration of the lanthanides in nitrate solutions. (auth)

11638 SOME OBSERVATIONS OF Np(VI) IN CHLORIDE SOLUTIONS. Donald Cohen and Brian Taylor (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 22: 151-3 (Dec. 1961).

Results are given which show that the reduction of Np(VI) in chloride media is very slow at room temperature, not differing greatly from that expected from auto-reduction, and that a satisfactory absorption spectrum can be obtained. The accelerated reduction observed in the presence of platinum is shown not to be due to a catalytic effect but to reduction by the platinum itself. The reduction of Np(VI) was found to be a little faster in both $DClO_4$ and DCl than in $HClO_4$ but still very slow. A major peak occurs at a longer wavelength in 2 M DCl than in 2 M $DClO_4$ and its molar extinction coefficient is increased from 46 to 2 M $DClO_4$ to 54 in 2 M DCl. (P.C.H.)

11639 THE THERMAL DECOMPOSITION OF ERBIUM AND LUTETIUM OXALATES. Abraham Glasner and Menachem Steinberg (Hebrew Univ., Jerusalem). J. Inorg. & Nuclear Chem., 22: 156-9(Dec. 1961).

The thermal decomposition behavior of erbium and lutetium oxalates was found to differ in many ways from that of the light rare earth group. On heating in vacuum at 300°C, the erbium and lutetium salts retained more than 25% of their water of crystallization. The last traces of water stabilizes the oxalates; decomposition in vacuum begins at 340 to 360°C, as with the light rare earth oxalates, but only after a long induction period. Initially carbonates are formed, and the CO disproportionates only to a small extent, about 17% with erbium oxalate and about 6% with lutetium oxalate. The carbonates are unstable and decomposition to the oxides follows soon. This reaction has an unstabilizing effect on eventual oxalato-carbonate intermediates. The regularities in the stability of the oxalates and in the disproportionation of CO, observed in the case of the light rare earths, are thus seen to extend also to the heavy rare earths. (P.C.H.)

11640 THE INFRA-RED SPECTRA AND STRUCTURES OF SOME HYDRATED URANIUM TRIOXIDES AND AMMONIUM DIURANATES. A. M. Deane (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 21: 238-52(Dec. 1961).

The infrared spectra of UO_4, $2H_2O$; UO_3, $2H_2O$; UO_3, $1H_2O$; UO_3, $0.8H_2O$, and UO_3 are shown, together with those of UO_3, $2D_2O$, and UO_3, $0.8D_2O$. The principal bands were assigned and some conclusions drawn concerning the structure. An empirical relationship between ν_{OH}, δ_{OH}, and ν_{UO} frequencies is shown. The infrared spectra of a number of samples of ammonium diuranate were also examined. Two of these samples were shown by detailed comparison with the spectra of the UO_3 hydrates to be in the form $UO_2(OH)_2 \cdot xNH_3 \cdot yH_2O$, and the spectra of other samples are also consistent with this structure. The composition is very variable and chemical analysis was performed on some of the samples; these results are included. (auth)

11641 THE SCANDIUM CHLORIDE–CESIUM CHLORIDE PHASE DIAGRAM. R. Gut and D. M. Gruen (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 21: 259-61 (Dec. 1961).

The phase diagram of the $ScCl_3$–CsCl binary system was investigated by differential thermal analysis. The system contains a congruent melting 3:1 compound Cs_3ScCl_6 (mp 814°C) and a 3:2 compound $Cs_3Sc_2Cl_9$ with a peritectic point at 619°C. Two eutectic points were found at 613 and 569°C corresponding to compositions of 6.5 and 56.5 mole % $ScCl_3$, respectively. No other phase transitions except that of CsCl were observed. (P.C.H.)

11642 A SPECTROPHOTOMETRIC STUDY OF THE THORIUM–β-HYDRONAPHTHAZARIN DISULPHONATE SYSTEM. R. S. Bottei and P. L. Gerace (Univ. of Notre Dame, Ind.). J. Inorg. & Nuclear Chem., 21: 265-77(Dec. 1961).

A spectrophotometric study of the reaction between thorium ion and β-hydronaphthazarin disulfonate (dipotassium 1,2,3,4-tetrahydro-5,8-dihydroxy-1,4-diketonaphthalene-2,6-disulfonic acid) in aqueous solution showed

that two water-soluble complexes were formed, a green complex with a metal to ligand ratio of 1:1 and a blue complex with a metal to ligand ratio of 2:1. The green complex with an absorption maximum at 460 mμ was formed with β-hydronaphthazarin disulfonate, while the blue complex with absorption maxima at 570 and 610 mμ was formed with naphthazarin disulphonate. A study of the related thorium-β-hydronaphthazarin system indicated that complex formation does not occur unless conditions were such that the ligand was oxidized to naphthazarin. (auth)

11643 A NOTE ON PEROXY-OXALATES OF URANIUM. N. S. Krishna Prasad (Atomic Energy Establishment, Trombay, India). J. Inorg. & Nuclear Chem., 21: 379-80(Dec. 1961).

The formation of uranium peroxy-oxalates was studied, and it was found that pH plays an important role in the formation of different compositions. The product obtained was $(NH_4)_2U_2O_8C_2O_4 \cdot 4H_2O$ (found: U 59.33%, peroxide oxygen 4.0%, oxalate ($C_2O_4^{2-}$) 11%; calculated: U 59.5%, peroxide oxygen 4.0%, oxalate 11%). A solution of ammonium uranyl oxalate when treated with excess H_2O_2 showed a deeply colored solution in the pH range 4 to 8.5, the color of the solution changing from yellow to orange with increase in pH. Preliminary studies on the absorption spectra of mixtures of uranyl nitrate, ammonium oxalate, and hydrogen peroxide indicated the formation of a complex. (P.C.H.)

11644 X-RAY DIFFRACTION STUDIES ON COMPOUNDS RELATED TO URANIUM TRIOXIDE DIHYDRATE. E. V. Garner (United Kingdom Atomic Energy Authority, Capenhurst, Ches., Eng.). J. Inorg. & Nuclear Chem., 21: 380-2(Dec. 1961).

Studies were made on the crystal structure of compounds formed by adding alkali to solutions of uranyl salts and also ammonium diuranate, the orange-yellow material formed when ammonia is the precipitating agent. Under conditions of rapid precipitation, the products tend to be poorly crystalline, giving x-ray diffraction patterns consisting of relatively few, somewhat diffuse reflections. However, by adding a quantity of ammonia just insufficient to produce a permanent precipitate, and allowing the solution to stand, a highly crystalline product (of approximate composition $UO_3 \cdot 1\frac{3}{4}\ H_2O \cdot \frac{1}{4}NH_3$) was obtained. To account for weaker lines on the pattern, a cell with a trebled b axis and a doubled c axis is necessary. The true cell, therefore, has the dimensions: a = 7.16, b = 12.21, c = 14.06 Å. With changes in conditions of precipitation, variations in the composition of the ammonia precipitates are found, together with modifications of the diffraction pattern. (P.C.H.)

11645 URANIUM-BEARING GLASSES IN THE SILICATE AND PHOSPHATE SYSTEMS. C. D. Wirkus and D. R. Wilder (Ames Lab., Ames, Iowa). J. Nuclear Materials, 5: 140-6(Jan. 1962). (IS-276). (In English)

The compositional aspects of high uranium content silicate and phosphate glasses were studied. Highly stable silicate glasses were prepared containing up to 45 wt % UO_2. In the phosphate system comparatively stable glasses with UO_2 contents as high as 40 wt % were produced. An intermediate oxide, such as TiO_2 or Al_2O_3 and/or a modifier, such as Na_2O was required in the preparation of uranium silicate glass. Glasses consisting entirely of urania and phosphorus pentoxide were prepared and the addition of alumina increased the durability of the uranium phosphate glasses. The best glasses from each system were highly devitrification-resistant and virtually insoluble in boiling water and most common reagents. HF attacked glasses in both systems and NaOH decomposed the phosphate glasses but not the silicates. Densities of the glasses ranged up to 3.5ᶠ g/cm³. In general, those glasses with the highest uranium contents had the highest densities. The linear thermal expansion coefficient for a typical silicate glass was 6.8×10^{-6}/°C and for a typical uranium phosphate glass, 5.5×10^{-6}/°C. (auth)

11646 HYDROLYSIS OF THORIUM CARBIDES. J. J. Lawrence and D. J. O'Connor (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). J. Nuclear Materials, 5: 156-7(Jan. 1962). (In English)

The effects of exposing compacts and powders of thorium monocarbide and dicarbide to laboratory air, water, and electrolyte solutions are summarized. The study has application to the fabrication of thorium-uranium carbide fuels and to their processing after irradiation. Results show that both thorium monocarbide and dicarbide readily hydrolyze on exposure to laboratory air. On hydrolysis both carbides exfoliate, increase in weight and produce a finely divided hydrolysis product, probably thorium dioxide. Solid, liquid, and gaseous hydrocarbon products were also produced, and hydrolysis was accompanied by a distinct hydrocarbon odor. Approximately 2×10^{-3} mole of hydrocarbon gas per gram of hydrolyzable thorium are evolved when lump samples of thorium carbide are hydrolyzed in water, acid, or alkali solutions at temperatures from 23 to 90°C; the total gas evolution was independent of temperature in this range. Since the hydrolysis is so rapid in air and water, fuels containing thorium carbide should be fabricated in an inert atmosphere and be clad to prevent hydrolysis on subsequent exposure to air. (N.W.R.)

11647 LOW TEMPERATURE THERMAL REDUCTION OF ZIRCONIUM TETRACHLORIDE WITH ALKALI METALS. Josef Valeček. Jaderná energie, 8: 21-2(1962). (In Czech)

Description is given of a novel method of $ZrCl_4$ reduction with alkali metals at low temperatures without using pressure vessels and large charges. (auth)

11648 TECHNETIUM CHLORIDES. R. Colton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 193: 872-3(Mar. 3, 1962).

Reaction between Tc metal and a Cl_2 stream began at ~200°C and was rapid at 400°C. A dark green solid was first formed ($TcCl_{\sim 1}$) which is very unstable, decomposing to the stable red tetrachloride on gentle heating in a Cl_2 stream or on standing for a few hours at room temperature. (D.L.C.)

11649 HYDROGEN–DEUTERIUM EXCHANGE ON CLEAN NICKEL SURFACES. D. Shooter and H. E. Farnsworth (Brown Univ., Providence). Phys. and Chem. Solids, 21: 219-27(Dec. 1961). (In English)

A reaction chamber was developed for measuring the catalytic activity of small samples cleaned by argon ion bombardment. It has two compartments. Cleaning of the catalyst takes place in the lower compartment and it is then transferred to the upper compartment which contains no other active materials. Activity measurements were made with the two compartments isolated from each other by a ground glass valve. Hydrogen–deuterium exchange was studied on a solid polycrystalline nickel catalyst. Gas mixtures were analyzed with an omegatron mass spectrometer. The rate of reaction on the clean surface was 8.8×10^{16} molecules cm^{-2} sec^{-1} (p = 1mmHg, T = 293°K). Measurements were made of the activity as a function of pressure, contamination, and conditions of ion bombardment. (auth)

11650 STUDY OF NIOBATES AND TANTALATES OF BIVALENT TRANSITION METALS. E. F. Bertaut, L. Corliss, F. Forrat (Centre d'Etudes Nucleaires, Grenoble, France), R. Aleonard, and R. Pauthenet. Phys. and Chem. Solids, 21: 234-51(Dec. 1961). (In French)

The structure of $A_2M_4O_9$ (A = Nb, Ta; M = Mn, Fe, Ni, Co, Mg) was studied by x rays. The structure is derived from the corundum type structure ($\alpha - Al_2O_3$) by an ordering of the cations A and M. The most probable space group is P $\bar{3}$ c 1. Magnetic measurements and neutron diffraction show the antiferromagnetic nature of $Nb_2Mn_4O_9$ and $Nb_2Co_4O_9$. The spins form chains along the lines $\frac{1}{3}\ \frac{2}{3}$ z (+ spins) and $\frac{2}{3}\ \frac{1}{3}$ z (– spins). (auth)

11651 GRAVIMETRIC STUDIES OF THE DEFECT STRUCTURE OF α-Nb_2O_5. Per Kofstad and Per Bjørn Anderson (Central Inst., for Industrial Research, Blindern, Oslo, Norway). Phys. and Chem. Solids, 21: 280-6(Dec. 1961). (In English)

The defect structure of non-stoichiometric α-Nb_2O_5 in the temperature range 900–1400°C was studied by a gravimetric method. The relative, isothermal weight change of α-Nb_2O_5 equilibrated in mixtures of CO and CO_2 was found to be proportional to $p_{O_2}^{-1/6}$. This clearly establishes that the defect structure of oxygen-deficient α-Nb_2O_5 involves oxygen vacancies. Thermodynamic properties of the defect equilibrium and the partial molar thermodynamic properties of dissociation of oxygen in non-stoichiometric α-Nb_2O_5 were calculated. (auth)

11652 ELECTRICAL RESISTIVITY AND PARAMAGNETIC RESONANCE IN GADOLINIUM HEXABORIDE. B. R. Coles, T. Cole, J. Lambe, and N. Laurance (Ford Motor Co., Dearborn, Mich.). Proc. Phys. Soc. (London), 79: 84-6(Jan. 1, 1962).

Magnetic susceptibility measurements on GdB_6 were interpreted in terms of an antiferromagnetic interaction between $4f^7$ ion cores via one conduction electron per gadolinium atom. Electrical resistivity data are presented which show the spin–disorder contribution to be expected on this basis, and a large effect ascribed to short-range order above the Néel temperature. An electron spin resonance was also observed; this has the characteristics expected of a $4f^7$ ion in a metallic matrix and cannot be observed in the antiferromagnetic temperature range. (auth)

11653 SOME EFFECTS OBSERVED BY ELECTRON SPIN RESONANCE OF THE DIFFUSION OF MANGANESE INTO THE CALCIUM AND STRONTIUM FLUORIDE LATTICES. G. F. J. Garlick, A. Cunliffe, and M. N. Jones (Univ. of Hull, Eng.). Proc. Phys. Soc. (London), 79: 223-5 (Jan. 1, 1962).

The x-band electron spin resonance spectra of calcium or strontium fluoride powder mechanically mixed with manganese fluoride, manganese ammonium fluoride, or manganese dioxide powder were observed immediately after mixing, after periods of time, and after heating at various temperatures in an argon stream or in air. The proportion of manganese to calcium or strontium was 0.5%. The spectrum immediately after mixing is that of the manganese compound alone. Subsequent spectra depended on the grain size of the alkaline earth fluoride powder. (L.N.N.)

11654 GROWTH OF CADMIUM FLUORIDE CRYSTALS FROM THE MELT. D. A. Jones and R. V. Jones (Univ. of Aberdeen, Scotland). Proc. Phys. Soc. (London), 79: 351-7 (Feb. 1, 1962).

Cadmium fluoride crystals up to 15 cm in diameter and 12 cm in length were grown from the melt by the Stockbarger process. Difficulties include the tendency of the melt to evaporate and to dissociate, and for a 'crust' to form on the crystal. It is possible to choose an operating pressure (2 mmHg) such that the undissociated material stays in the crucible, while any free cadmium produced by dissociation can evaporate, giving a crystal transmitting down to about 2060Å. Furnace details and operating conditions are described, and temperature gradient effects are discussed. (auth)

11655 STRUCTURE OF POTASSIUM BISULFATE CRYSTALS WITH CERIUM AND LANTHANUM. V. I. Grebenshchikov and V. N. Bobrova. Radiokhimiya, 3: 645-9(1961). (In Russian)

A method for determining the composition of the adsorption compound in mixed crystals is described. It is shown that Ce^{3+} and La^{3+} with K_2SO_4 form mixed crystals by double salt co-crystallization, $K_5La(SO_4)_4$ and $K_5Ce(SO_4)_4$ with K_2SO_4. (R.V.J.)

11656 CO-PRECIPITATION OF Am^{3+} WITH BINARY POTASSIUM LANTHANUM SULFATE IN SULFURIC ACID. V. I. Grebenshchikova and N. B. Chernyavskaya. Radiokhimiya, 3: 650-3(1961). (In Russian)

The influence of complexing on the distribution coefficient of Am^{3+} in sulfuric acid was analyzed. The composition of binary potassium lanthanum sulfates in sulfuric acid was analyzed, and the crystallization of Am^{3+} and La^{3+} in various sulfuric acid concentrations was determined. (R.V.J.)

11657 ON THE NATURE OF COLLOIDAL BEHAVIOR OF AMERICIUM. I. E. Starik and F. L. Ginzburg. Radiokhimiya, 3: 685-9(1961). (In Russian)

It is postulated that the colloidal behavior of Am at pH 6 to 8 is determined by sorption on negatively charged silicic acid particles in the solution. Centrifuge and electromigration methods were used for determining the fine-dispersion phase of true americium colloid concentrations in solutions with pH > 9. It is shown that paramagnetic resonance of $Am(OH)_3$ is reached not at pH = 6 to 7, which corresponds to the sorption curve maximum, but at higher pH values. (R.V.J.)

11658 PROTACTINIUM IN AQUEOUS SOLUTIONS. V. THE EXISTENCE OF PSEUDOCOLLOIDS. I. E. Starik, L. D. Sheidina, and L. I. Il'Menkova. Radiokhimiya, 3: 690-3(1961). (In Russian)

A centrifuge method was used for identifying true protactinium colloids and pseudocolloids. Protactinium pseudocolloids in equilibrium with ion forms were found in nitric acid solutions at pH 4 to 6. The true protactinium colloids start to form at pH 5, and at pH 7 most protactinium is in the colloidal state. It is postulated that the pseudocolloidal state forms in alkali (pH 12 to 14) due to a partial recharge of true colloids. (R.V.J.)

11659 COMPLEX FORMATION OF AMERICIUM AND CURIUM WITH α-OXYISOBUTYRIC ACID. V. B. Dedov, I. A. Lebedev, M. N. Ryzhov, P. S. Trukhlyaev, and G. N. Yakovlev. Radiokhimiya, 3: 701-5(1961). (In Russian)

Ion exchange chromatography was used in studies of trivalent actinate separation. The formation of complex $Am(o\text{-But})^{2+}$, $Am(o\text{-But})_2^{+}$, $Am(o\text{-But})_3$, $Cm(o\text{-But})^{2+}$, $Cm(o\text{-But})_2^{+}$, and $Cm(o\text{-But})_3$ was observed during Am(III) and Cm(III) sorption on KU-2 cations of ammonium α-oxyisobutyrate. The concentration of α-oxyisobutyrate ions varied from 6×10^{-4} to 3×10^{-1} M at a constant ion strength of 0.5. The stability constants of the complex ions were determined at 0.5 and zero ion strength. (R.V.J.)

11660 SPECTROPHOTOMETRIC ANALYSIS OF U(VI) FLUORINE COMPLEX COMPOUND. A. F. Kuteinikov. Radiokhimiya, 3: 706-11(1961). (In Russian)

Uranyl ion reactions with fluorine in the presence of arsenazo were analyzed, and it was found that complex UO_2F^- is formed. The stability of the complex ion is characterized by the instability constant 1.7×10^{-5}. (R.V.J.)

11661 PROPERTIES OF URANIUM OXYFLUORIDES IN SOLUTIONS. I. V. Tananaev and E. N. Deichman. Radiokhimiya, 3: 712-18(1961). (In Russian)

The reaction of UO_2^{2+} with F ions was studied in $UO_2(NO_3)_2-PbCl-H_2O$, $UO_2(NO_3)_2-CaF-H_2O$, and $UO_2(NO_3)_2-HF-H_2O$ systems. The solubility of PbFCl and CaF_2 in $UO_2(NO_3)_2$ solutions and reactions with HF show that UO_2^{2+} fluorination is achieved in two steps, producing UO_2F^+ (dissociation constant 4×10^{-5}) and UO_2F_2. (R.V.J.)

11662 SEPARATION OF Pa BY ION EXCHANGE AND PROPERTIES OF SOME Pa COMPOUNDS. I. A. Lebedev, S. V. Pirozhkov, V. M. Semochkin, and G. N. Yakovlev. Radiokhimiya, 3: 760-1(1961). (In Russian)

Pa^{231} was produced in $Th^{230}(n,\gamma)Th^{231} \xrightarrow[25.6\ hr]{\beta^-} Pa^{231}$ reactions and separated by anion exchange. An integral neutron flux of 2.6×10^{20} n/cm^2 was used. Chemical treatments produced 6.5 ml of protactinium solution with ~3% admixtures. Some of the chemical properties of prepared protactinium hydroxide, oxide, iodate, and phenylarsonate are described. (R.V.J.)

11663 X-RAY AND ELECTRICAL INVESTIGATION OF SAMPLES IN THE SYSTEM $PbTiO_3$. S. A. Fedulov, Yu. N. Venevtsev, G. S. Zhdanov, and I. S. Rez (Karpov Physicochemical Inst., USSR). Soviet Phys.-Cryst., 6: 547-50(Mar.-Apr. 1962).

The existence of a continuous series of solid solutions in the $PbTiO_3-BaZrO_3$ system was established. The variation of the parameters of the crystal lattice of the solid solutions with composition was studied. The temperature dependence of the dielectric permeability, of the tangential dielectric losses, and conductivities for samples of different composition were investigated, and coefficients of electromechanical coupling for samples of certain compositions were determined. The phase diagram of solid solutions in the lead titanate–barium zirconate system was constructed. (auth)

11664 AN X-RAY STUDY OF THE PHASE TRANSITION IN Sr_2FeNbO_6. M. F. Kupriyanov and E. G. Fesenko (Rostov-on-Don State Univ., USSR). Soviet Phys.-Cryst., 6: 639(Mar.-Apr. 1962).

The analogous compounds Sr_2FeNbO_6 and Sr_2FeTaO_6 were prepared from stoichiometric mixtures of $SrCO_3$, Fe_2O_3, and Ta_2O_5 or Nb_2O_5. The products were examined by x-ray methods and found to consist each of one phase only (within the sensitivity of the method). The patterns indicate that the two compounds have perovskite structure; the distortion is tetragonal and the unit-cell parameters are very similar. The parameters of Sr_2FeNbO_6, as determined at room temperature, are $a = 3.952 \pm 0.001$, $c = 3.972 \pm 0.001$ Å. The nature of the predicted phase transition for Sr_2FeNbO_6 shows that the transition temperature is high, although the spontaneous deformation is small at room temperature. (P.C.H.)

11665 CONTROLLED CRYSTALLIZATION CONDITIONS FOR THE PRODUCTION OF MONOCRYSTALS OF $Y_3Fe_5O_{12}$. V. A. Timofeeva and R. A. Voskanyan (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst., 6: 641-3(Mar.-Apr. 1962).

The system $PbO-PbF_2-Y_3Fe_5O_{12}$ was examined by thermal analysis for the purpose of finding methods of producing controlled crystallization in $Y_3Fe_5O_{12}$. At 1300°C a 1:1 mixture of lead oxide and fluoride will dissolve about 40% of $Y_3Fe_5O_{12}$, which crystallizes completely at 1100°C when the cooling is rapid. The density of the solvent is much larger than that of the solute in the system $PbO-PbF_2-Y_3Fe_5O_{12}$; on this basis attempts were made to crystallize the $Y_3Fe_5O_{12}$ in the upper part of the crucible. If a thin monocrystalline layer (which acts as a seed) is produced, all the dissolved $Y_3Fe_5O_{12}$ crystallizes as a layer at the surface. The ferrite crystals then grow only on the rhombic dodecahedron faces, whereas in spontaneous crystallization the crystal grows with a great variety of faces. It is concluded that conditions for controlled crystallization of $Y_3Fe_5O_{12}$ exist if a saturated solution of $Y_3Fe_5O_{12}$ is prepared at 1260 to 1280°C, a little extra $Y_3Fe_5O_{12}$ is introduced in order to produce supersaturation at the surface, the temperature is reduced rapidly by 30 to 40°C in order to produce a thin seed film, and the temperature is then reduced smoothly at the rate of 2 to 3° per hour from the maximum temperature to 1100°C. (P.C.H.)

11666 SORET COEFFICIENTS AND HEATS OF TRANSPORT OF SOME SALTS OF ALKALINE EARTH METALS IN WATER AT 25°C. A. D. Payton and J. C. R. Turner (Dept. of Chemical Engineering, Cambridge, [Eng.]). Trans. Faraday Soc., 58: 55-9(Jan. 1962).

The Soret effect was investigated in aqueous solutions at 25°C. The salts studied were $CaCl_2$ and $SrCl_2$ at 0.005 m, and $MgCl_2$, $BaCl_2$, and $MgSO_4$ from about 0.0005 to 0.01 m or higher. Results are compared with those for other salts obtained using the same apparatus. (auth)

11667 CONDUCTANCE OF POTASSIUM CHLORIDE IN THE SOLID STATE. A. R. Allnatt and P. W. M. Jacobs (Imperial Coll. of Science and Tech., London). Trans. Faraday Soc., 58: 116-31(Jan. 1962).

The theory of the ionic conductance of alkali halide crystals is reviewed, and an appraisal of experimental results is made in the light of this theory. It is concluded that sufficient experimental data to provide a test of the Lidiard (Phys. Rev., 94: 29(1954)) theory are not available. Experimental results on the d-c and a-c conductance of potassium chloride crystals and of KCl crystals doped with strontium chloride are described. These results are not in accord with the simple association theory and qualitatively favor the interpretation based on non-nearest neighbor interactions. A value of 0.3 ± 0.1 ev is deduced for ζ, where $-\zeta$ is the free energy of association of complexes, the wide limits being set by the curious temperature dependence found for ζ. Numerical values for the heat of formation of a Schottky pair of vacancies and for the activation energy for electrical migration of cation and anion vacancies are deduced. These are, respectively, $h = 2.30$, $\Delta h_1 = 0.75$, $\Delta h_2 = 1.8$ ev. (auth)

11668 A PROTON MAGNETIC RESONANCE STUDY OF PHASE TRANSITIONS IN RUBIDIUM AND CAESIUM STEARATES. D. J. Shaw and B. A. Dunell (Univ. of British Columbia, Vancouver). Trans. Faraday Soc., 58: 132-7 (Jan. 1962).

The proton magnetic resonance absorption in anhydrous rubidium and cesium stearates was studied at 88 to 440°K. Abrupt changes in line width and second moment were observed at 350 and 416°K for rubidium stearate and at 342 and 373°K for cesium stearate. These correspond approximately to known phase transitions and were confirmed by x-ray measurements. The results suggest that the first of these transitions involves the onset of rotation of the hydrocarbon chains about their long axes and that the chain

spacings depend on the radius of the cation. After the second of these transitions, the hydrocarbon chains may be free to move about other axes while still maintaining an average position in the crystal lattice. (auth)

11669 SELF-DIFFUSION OF SODIUM IONS IN ANALCITE AND ANHYDROUS ANALCITE. D. Barlow and I. R. Beattie (King's Coll., London). Trans. Faraday Soc., 58: 138-44(Jan. 1962).

The application of equations to describe self-diffusion in a solid in contact with a well-stirred solution is discussed. The self-diffusion coefficients of Na^{22} ions in analcite were measured under a variety of experimental conditions; it is shown that at low molarities, an anomalously low self-diffusion coefficient is apparent. The self-diffusion of Na^{22} ions in anhydrous analcite shows a much lower activation energy than that found by conductivity measurements. (auth)

11670 THE CALCULATION OF THE DIFFUSION OF RADIOACTIVE GASES. I. (RARE GAS DIFFUSION IN SOLID BODIES. 6). H. Gaus (Hahn-Meitner-Institut für Kernforschung, Berlin). Z. Naturforsch., 16a: 1130-5 (Nov. 1961). (In German)

The diffusion of radioactive gases from sample bodies was calculated with the elementary diffusion equation. The time behavior of the resulting activity was calculated in a continuation of a work by Inthoff and Zimen for spheres, cylinders, and parallelepipeds when no new production occurs. Possible diffusion before the start of measurements was rigorously taken into account by calculations with time-dependent diffusion constants, and the behavior of the resulting gas current was discussed. In a subsequent work, the diffusion in new production was considered in a corresponding manner. (tr-auth)

11671 STUDIES OF EQUILIBRIUM IN REDUCTION REACTION OF HfO_2 BY CARBON AT ELEVATED TEMPERATURES. V. I. Zhelankin, V. S. Kutsev, and B. F. Ormont (Karpov Inst. of Physics and Chemistry, USSR). Zhur. Fiz. Khim., 35: 2608-10(Nov. 1961). (In Russian)

Equilibrium in HfO_2 reduction with carbon at 1200 to 2000°K and 70 to 1000 mm mercury pressure was studied. The oxycarbide formed has a practically constant composition and constant lattice values with nonstoichiometric HfC containing traces of oxygen. The reaction is expressed by the equation $HfO_2 + 2.9\ C \approx HfC_{0.95}O_{0.05} + 1.95\ CO$. The equilibrium is monovariant. The heat of formation and entropy of the oxycarbide are calculated for 298.1°K. (R.V.J.)

11672 THERMODYNAMIC PROPERTIES OF MAGNESIUM(VI) MOLYBDATE. T. N. Rezukhina, V. A. Levitskii, and N. M. Kazimirova (Moscow State Univ.). Zhur. Fiz. Khim., 35: 2639-42(Nov. 1961). (In Russian)

Thermodynamic properties of magnesium(IV) molybdate at 1100 to 1300°K were measured, and thermodynamic parameters were found for $MgO + Mo + {}^3/_2O_2 \rightarrow MgMoO_4$. The heat capacity of $MgMoO_4$ is $C_p = 25.19 + 12.6 \times 10^{-3}$ T cal/degree/mole. For $Mg + Mo + 2O_2 \rightarrow MgMoO_4$, it is shown that $\Delta H^0_{298^\circ} = -341.2$ kcal and $\Delta Z^0_{298} = -315.1$ kcal. (R.V.J.)

11673 THE EQUATION OF STATE FOR D_2O. N. P. Suvorov. Zhur. Fiz. Khim., 36: 216-18(Jan. 1962). (In Russian)

An equation of state for heavy water for the range from 0°C to the critical point and for pressures up to 12000 kg/cm^2 was used for determining the maximum density at 1 atm with an accuracy of 0.6%. (R.V.J.)

11674 COMPLEX U(IV) CARBONATE COMPOUNDS. V. A. Golovnya and G. T. Bolotova. Zhur. Neorg. Khim., 6: 2481-7(Nov. 1961). (In Russian)

Complex carbonate compounds of tetravalent uranium, $(CN_3H_6)_6[U(CO_3)_5] \cdot 5H_2O$, $(CN_3H_6)_3(NH_4)_3[U(CO_3)_5] \cdot 2H_2O$, $[Co(NH_3)_6]_2[U(CO_3)_5] \cdot 4H_2O$, $5H_2OK_6[U(CO_3)_5] \cdot 6H_2O$, $(CN_3H_6)_3NH_4[U(CO_3)_4] \cdot 4H_2O$, $C_2N_2H_{10}[U(CO_3)_3 \cdot 2H_2O] \cdot 2H_2O$, $(C_2N_2H_{10})_2[U_2(CO_3)_5(OH)_2 \cdot 4H_2O] \cdot 2H_2O$, and $C_2N_2H_{10}[U(CO_3)_2(OH)_2 \cdot 2H_2O] \cdot H_2O$, were synthesized. The compounds are considered to be a single generic series of complex salts with a constant coordination number of 8. It is postulated that the internal sphere of pentacarbonate complex is a hexagonal bipyramid with 3 CO_3 groups occupying 2 coordination sites at the base and 2 CO_3 groups at the apex. (R.V.J.)

11675 COMPLEX URANIUM(IV) CARBONATE–OXALATE COMPOUNDS. V. A. Golovnya and G. T. Bolotova. Zhur. Neorg. Khim., 6: 2488-95(Nov. 1961). (In Russian)

Two mixed crystalline compounds, $(CN_3H_6)_3NH_4[U(CO_3)_3C_2O_4] \cdot 2H_2O$ and $(CN_3H_6)_8(NH_4)_2[U_2(CO_3)_8C_2O_4] \cdot 4H_2O$, were separated by guanadine carbonate reaction with ammonium uranium tetroxalate. From sodium and potassium oxalate carbonate solutions, mixed compounds of uranium composed of carbonate, oxalate, and hydroxyl ions were separated: $Na_4[U_2C_2O_4(CO_3)_3 \cdot 4OH \cdot 4H_2O]$, $K_7[U(C_2O_4)_2(CO_3)_3 \cdot OH] \cdot 6H_2O$, and $K_{16}[U_2(C_2O_4)_3(CO_3)_8 \cdot 2OH] \cdot 10H_2O$. The appearance of hydroxyl ions is a result of high potassium and sodium carbonate solution pH in comparisons to ammonium and guanadine. The analysis indicates that all synthesized uranium(IV) oxalate–carbonate compounds are of the two-nuclei type. (R.V.J.)

11676 COMPLEX FORMATION OF ZIRCONIUM WITH ORGANIC ACID ANIONS IN SOLUTIONS. K. B. Yatsimirskii and L. P. Raizman (Ivanov Inst. of Chemistry and Tech., USSR). Zhur. Neorg. Khim., 6: 2496-2503(Nov. 1961). (In Russian)

The formation of zirconium complexes in oxalic, malonic, succinic, and tartaric acids was analyzed. In Zr(IV) oxalates, malonates, and succinates the addend–metal ratio is 1:1, while the tartarates form two compounds. Complex zirconium tartarates and succinates possess a catalytic activity. The nominal equilibrium constants are calculated for the formation of $[Zr(OH)C_2O_4]^+$, $[Zr(OH)_3C_2H_2O_4]^-$, $[Zr(OH)C_4H_4O_4]^+$, $[Zr(OH)C_4H_4O_6]^+$, and $[Zr(C_4H_4O_6)_2]$. (R.V.J.)

11677 INVESTIGATIONS OF Li_2SO_4–$BeSO_4$ SYSTEMS. I. I. Bosik, A. V. Novoselova, and Yu. P. Simanov. Zhur. Neorg. Khim., 6: 2563-7(Nov. 1961). (In Russian)

Thermogravimetric, thermal, and x-ray analyses were made of Li_2SO_4–$BeSO_4$ systems (0 to 40% $BeSO_4$). Alpha and β modifications of Li_2SO_4 form limited solid solutions with $BeSO_4$ with a maximum $BeSO_4$ content of 15%. The parameters of $BeSO_4$ β and γ modifications were determined: β-$BeSO_4$ (stable at 590 to 635°C) has a rhombic lattice with $a = 6.68 \pm 0.01$ Å, $b = 4.60 \pm 0.005$ Å, and $c = 4.67 \pm 0.005$ Å; γ-$BeSO_4$ forms at 635 to 640°C with $a = 6.64 \pm 0.03$ Å. (R.V.J.)

11678 THERMODYNAMICS OF BINARY SYSTEMS OF ALKALI CHLORIDES WITH RARE EARTHS. A. K. Baev and G. I. Novikov (Leningrad State Univ.). Zhur. Neorg. Khim., 6: 2610-11(Nov. 1961). (In Russian)

Binary systems of alkali chlorides (Na and K) with rare earths (La, Ce, Pr, and Nd) were studied by thermographic methods and the enthalpy and entropy were determined. The characteristics of the systems are tabulated, and the inter-solubility of the components was confirmed. Data for ΔH and ΔS are also tabulated. (R.V.J.)

11679 ON THE SOLUBILITY OF $Cs_2Ca[Fe(CN)_6]$. A. V. Kositsyn (Inst. of Radiation Hygiene, USSR). Zhur. Neorg. Khim., 7: 58-61(Jan. 1962). (In Russian)

The solubility of $Cs_2Ca[Fe(CN)_6]$ in water is $(3.6 \pm 0.5) \times 10^{-5}$ mol/l at 25°C. The solubility of $Cs_2Ca[Fe(CN)_6]$ in KCl and NaCl solutions increases with electrolyte concentration reaching 7.7×10^{-4} mol/l at a KCl concentration of 0.9 mol/l. In CaCl solutions the solubility is compensated by increased Ca^{2+} precipitant. The solubility reaches 3 to 6×10^{-4} mol/l in solutions containing 2.5×10^{-3} mol/l of $Ca_2[Fe(CN)_6]$. (R.V.J.)

11680 THERMOCHEMISTRY OF LANTHANUM COMPLEX FORMATION WITH ETHYLENEDIAMINETETRAACETATE. K. B. Yatsimirskii and G. A. Prik (Ivanovsk Inst. of Chemistry and Tech., USSR). Zhur. Neorg. Khim., 7: 62-5(Jan. 1962). (In Russian)

Calorimetric measurements were taken of the heat produced by mixing $La(NO_3)_3$ and trilon B solutions and in the dissolution of 0.5 mole of $La(NO_3)_3$ containing 0.6 mole of KNO_3 in KCl in a mixture with ionic strength 0.45. The caloric effect in lanthanum complex formation with EDTA is -4.1 ± 0.1 kcal/mol and the ΔS is 53 cal/mol. The equation for binding in trivalent complex formation is verified. (R.V.J.)

11681 APPLICATION OF ION EXCHANGE IN STUDIES OF COMPLEX FORMATION OF Zr AND Hf WITH SULFATE ION. D. I. Ryabchikov, A. N. Ermakov, V. K. Belyaeva, I. N. Marov, and K'o-min Yao. Zhur. Neorg. Khim., 7: 69-75(Jan. 1962). (In Russian)

Zr and Hf complexing with sulfate ion in perchloric acid solution at $[H^+] = 2.33$ was studied by cation exchange. In concentrations of sulfuric acid up to 0.1 mole/l, zirconium forms three complexes with $M:H_2SO_4 = 1:1$, 1:2, and 1:3, while Hf forms two complexes with $M:H_2SO_4 = 1:1$ and 1:2. The Fronaeus and Schubert and the least squares methods were used in calculating the equilibrium constants $K_j = \{[M(SO_4)^{4-2j}][H^+]^j/[M^{4+}][HSO_4^-]^j\}$; $K_1 = 361 \pm 12$, $K_2 = (2.17 \pm 0.15) \times 10^3$, and $K_3 = (4.06 \pm 1.2) \times 10^5$ for zirconium and $K_1 = 130 \pm 6$ and $K_2 = (2.09 \pm 0.1) \times 10^3$ for hafnium. The complex $M(SO_4)^{2+}$ was not absorbed by the cation. (R.V.J.)

11682 PRECIPITATION OF LANTHANUM VANADATES. V. G. Gulina, O. G. Nemkova, and V. K. Deikalov. Zhur. Neorg. Khim., 7: 84-7(Jan. 1962). (In Russian)

The precipitation and properties of low-solubility lanthanum vanadates with La:Va ratios = 1:1, 1:2, and 1:3 are described. (R.V.J.)

11683 AN ANHYDROUS $OsBr_4$. I. N. Semenov and N. I. Kolbin. Zhur. Neorg. Khim., 7: 218(Jan. 1962). (In Russian)

Anhydrous osmium tetrabromide was initially produced in a tube at bromine vapor pressure 6 to 10 atm. Tube temperatures were 500 to 550°C at the hot end and 150 to 200°C at the cool. $Br:O_3$ ratios were 3.93 to 3.96. Further experiments produced a purer product at 20 atm with 530 to 580°C at one end and 150 to 200°C at the other end of the tube. The anhydrous $OsBr_4$ is nonhygroscopic and insoluble in water, dilute hydrochloric acid, and concentrated HCl, HBr, HNO_3, and H_2SO_4. At 350 to 400°C $OsBr_4$ decomposes into tribromide and bromine. (R.V.J.)

11684 SYNTHESIS AND PURIFICATION OF BORON BROMIDE AND IODIDE. B. N. Ivanov-Emin, L. A. Nisel'son, and I. V. Petrusevich. Zhur. Priklad. Khim., 34: 2378-84(Nov. 1961). (In Russian)

The synthesis of boron bromide and boron iodide from elements and the purification of boron halides by rectification are described. (R.V.J.)

11685 BIBLIOGRAPHY ON URANIUM CARBIDES. Henry H. Hausner and Helen C. Friedemann. Reutte/Tyrol, Austria, Metallwerk Plansee Aktiengesellschaft, 1961. 39p.

Some of the physical properties of UC are listed, and a bibliography of 209 references, most with appended abstracts, is presented on uranium carbides. (D.L.C.)

Radiation Chemistry and Radiochemistry

Refer also to abstract 12674

11686 (NP-11448) RADIATION EFFECTS ON TEFLON. An Annotated Bibliography. William L. Hollister, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Feb. 1962. Contract AF04(647)-840. 43p. (SB-61-65)

The effects of nuclear radiation on the properties of Teflon were investigated. Of primary importance is the effect of nuclear radiation on Teflon insulation. It is shown in the literature that Teflon is seriously degraded by relatively low radiation-exposure doses. It is pointed out that fluorocarbons in general are lacking in radiation stability and Teflon appears to be the most sensitive of the fluorocarbons. It is also pointed out that fluorocarbons under irradiation evolve fluorine, which cause corrosion problems. One unique aspect of the radiation stability of fluorocarbons is that when they are irradiated in media other than oxygen, their radiation stability increases. (79 references.) (C.H.)

11687 (NYO-7986) RADIATION CHEMISTRY PROGRESS REPORT. Gilbert J. Mains (Carnegie Inst. of Tech., Pittsburgh). Jan. 31, 1962. Contract AT(30-1)-2007. 16p.

The formation of benzene in the radiolysis of acetylene has been studied in the absence and presence of mercury vapor at 262°C. The formation of large yields of C_6DH_5, $C_6D_2H_2$, and C_6D_5H in the radiolysis of a 1:1 mixture of C_2H_2 and C_2D_2 is cited as evidence against the formation of benzene by an exclusively triplet state mechanism. Studies of H_2-C_2D_2 and D_2-C_2H_2 systems appear to rule out an exclusively hydrogen atom chain mechanism. A mechanism involving both hydrogen atoms and C_2H radicals is under consideration. Studies of the mercury sensitized radiolysis and photolysis of ethane are included; a comparison of the photochemical and radiation chemical systems is made. Preliminary results on the effect of mercury on the H_2-D_2 radioinduced exchange are discussed. (auth)

11688 (RAI-304) A STUDY OF THE MECHANISM OF RADIATION-INDUCED GELATION IN MONOMER-POLYMER MIXTURES. Quarterly Summary Report, November 1, 1961–January 31, 1962. George Odian, Bruce S. Bernstein, Sidney Binder, and Robert Connolly (Radiation Applications Inc., Long Island City, N. Y.). Mar. 8, 1962. Contract AT(30-1)-2816. 25p.

Tensile strengths of polyethylene-difunctional monomer systems irradiated to doses up to 4.6 Mrads (Co^{60} source) were measured. Polyethylene-allyl methacrylate (equilibrium swollen) systems irradiated to 1.5 Mrads have tensile strengths at 100°C equal to that of monomer-free polyethylene irradiated to 15 Mrads. Polyethylene-allyl acrylate and polyethylene-allyl methacrylate irradiated to 4.6 Mrads have higher tensile strengths than monomer-free polyethylene after 75 Mrads. Ten tensile strength of polyethylene equilibrium swollen with either of these two monomers prior to Co^{60} irradiation rises markedly at the low doses tested. No dose rate dependency for gel content was observed for polyethylene equilibrium-swollen with

allyl methacrylate between 0.015 and 0.21 Mrads/hr. (auth)

11689 (TID-15020) RESEARCH IN NUCLEAR AND RADIOCHEMISTRY. Progress Report for Year Ending January 31, 1962. T. T. Sugihara (Clark Univ., Worcester, Mass.). Contract AT(30-1)-1930. 67p.

Progress in research in nuclear and radiochemistry is reported in 10 papers. Ten separate abstracts were prepared. (M.C.G.)

11690 (TID-15020(p.1-14)) A NEW ISOMER—Tc^{94g}. John M. Matuszek, Jr. (Clark Univ., Worcester, Mass.).

In studies of the $Nb^{93}(\alpha,xn)$ reaction large amounts of a 293-min. activity which followed technetium chemistry, was produced. The experiments showed that the mass of the isomer was 94. Coincidence and singles spectra, gamma energies, branching ratios, spin, and parity were determined. The decay scheme is presented. (M.C.G.)

11691 (TID-15020(p.15-22)) ISOMERIC NUCLIDES PRODUCED BY BOMBARDMENT OF NIOBIUM. John M. Matuszek, Jr. (Clark Univ., Worcester, Mass.).

Niobium oxide foils were used as targets for alpha bombardments to study the $Nb(\alpha,xn)$ reactions. Irradiations were carried out using a stacked foil technique. The isomeric pairs $Tc^{96,96m}$ and $Tc^{95,95m}$ were counted on a 6-mm-thick NaI(Tl) crystal which had an aluminum covering. The $Tc^{94,94m}$ isomers were also detected. All decay curves were analyzed using FRANTIC-709. (M.C.G.)

11692 (TID-15020(p.23-6)) ISOMERIC RATIO IN THE $In^{115}(\alpha,2p)$ REACTION. Norman Dudey (Clark Univ., Worcester, Mass.).

Studies of the ratio of formation cross sections for In^{117} and In^{117m} as produced in the $In^{115}(\alpha,2p)$ reaction were continued. The spins of the target nucleus In^{115} and of the products In^{117g} and In^{117m} are 9/2, 9/2, and 1/2, respectively. Data showed that the ratio of high spin to low spin is nearly constant (0.2 to 0.5) and favors the low-spin isomer between 19 and 27 Mev where it rises abruptly and appears to level off again with a broad maximum at about 35 Mev. Compound-nucleus processes may contribute above 29 Mev. Above 35 Mev direct interactions of a different nature from the earlier process appeared to be important. (M.C.G.)

11693 (TID-15020(p.27-34)) ISOMERIC CROSS-SECTION RATIO FOR THE $Te^{130}(p,pn)$ REACTION FROM 45-150 MEV. Christopher Gatrousis (Clark Univ., Worcester, Mass.).

The behavior of isomeric yield ratios beyond the energy region in which the compound-nucleus mechanism is expected to predominate is being studied. Choice of the $Te^{130}(p,pn)$ reaction was based on the large spin difference between the product isomeric states. Targets were prepared by slurrying enriched Te^{130} metal powder with cement onto thin aluminum foil. Proton energies of 45 to 150 Mev were used. A method was developed for radiochemical purification using paper chromatography. The purified samples were counted with an end-window, flow proportional counter and also with a NaI(Tl) detector feeding a multichannel analyzer. The ratio Te^{129m}/Te^{129g} varied from 1.23 ± 0.10 to 1.41 ± 0.20 at 45 to 100 Mev. (M.C.G.)

11694 (TID-15020(p.35-6)) ISOMERIC RATIO IN A SIMPLE DIRECT INTERACTION. Taku Matsuo (Clark Univ., Worcester, Mass.).

The isomeric ratio Sc^{44m}/Sc^{44g} in the reaction $Ca^{44}(p,n)$ with 40-Mev protons was measured. Results agreed with the assumption that the nature of the product nuclide, in terms of its level density and spin distribution, is the most important factor in determining the isomeric ratio. (M.C.G.)

11695 (TID-15020(p.37-41)) RECOIL STUDIES OF URANIUM FISSION FRAGMENTS. Victor E. Noshkin (Clark Univ., Worcester, Mass.).

The study of nuclear recoils from the proton-induced fission of U^{238} was continued. The study was directed primarily to shielded and semi-shielded nuclei. Data obtained for the ranges and recoil properties of Ga^{72}, Ag^{112}, I^{130}, Cs^{136}, and La^{140} are shown. Results indicated a direct proportionality between ranges and kinetic energies. (M.C.G.)

11696 (TID-15020(p.42-8)) FISSION OF RARE EARTH ELEMENTS. Per Aagaard (Clark Univ., Worcester, Mass.).

Some preliminary results are reported for the 155-Mev proton fission of Ho^{165}. The target films of Ho_2O_3 were irradiated in the circulating beam of the Harvard University synchrocyclotron. The chemical isolation of the various products was carried out on the entire target in sequential fashion. In general the final counting samples were obtained in solid form and counted on a beta proportional counter. The following products were determined: Ni^{66}, Cu^{64}, Cu^{67}, Zn^{69m}, Zn^{72}, Ga^{72}, As^{74}, As^{76}, As^{77}, Sr^{89}, Mo^{99}, I^{131}, and I^{133}. An 80-Mev proton bombardment of Tb^{159} was carried out. Preliminary results indicated that products in the mass region 70 were formed. (M.C.G.)

11697 (TID-15020(p.49-56)) ANGULAR-MOMENTUM EFFECTS IN DELAYED-NEUTRON EMISSION. T. T. Sugihara (Clark Univ., Worcester, Mass.).

In the studies of Pappas and Rudstam on the occurrence of delayed-neutron precursors, the probability of neutron emission by the daughter formed by β decay for a given precursor was calculated using the energies involved. It is shown that the probability should include factors which depend on angular momentum as well as energy. These factors will in general decrease the probability. The kind of information that can be obtained from these angular-momentum considerations is summarized for a few specific nuclides. (M.C.G.)

11698 (TID-15020(p.57-60)) SEPARATION OF CESIUM BY ION EXCHANGE ON THALLOUS PHOSPHOTUNGSTATE. Henri L. Caron (Clark Univ., Worcester, Mass.).

An investigation was made of the ion-exchange behavior of the monovalent ions K, Rb, Cs, and Ag with solid thallous phosphotungstate (TPT). The capacity of TPT for K, Rb, and Cs was found to be 0.1, 0.3, and 0.5 milliequivalent per gram of TPT, respectively. Because of the high specificity of TPT for cesium, the chief advantage of this method of ion exchange is in isolating cesium from complex solutions containing many other ions. The other ions studied do not exchange sufficiently with TPT to allow separation from each other. (M.C.G.)

11699 (TID-15020(p.61-4)) SEPARATION OF CALCIUM AND STRONTIUM ON CHELATING RESIN DOWEX A-1. Linda O'Janne (Clark Univ., Worcester, Mass.).

Studies were made of the separation of calcium and strontium using a 200 to 400 mesh chelating resin, usually in the hydrogen form and equilibrated with the eluting agent. The most satisfactory separation was obtained by a stepwise, gradient elution method. The elution was begun with a 0.2M glycine–HCl buffer solution of pH 2.80 and continued until strontium began to appear in the effluent. The eluent was then changed to a buffer solution

of pH 2.50. A strontium fraction was obtained in 64% yield which was decontaminated with respect to calcium by about a factor of 100 and a calcium fraction in 82% yield that was substantially free of strontium. (M.C.G.)

11700 (TID-15065) THE EFFECTS OF RADIATION ON CHEMICAL SYSTEMS. Progress Report [for] period January 1, 1961 to December 31, 1961. Alexander R. Amell (New Hampshire. Univ., Durham). Dec. 31, 1961. Contract AT(30-1)-1911. 18p.

The gamma-induced decolorization of solutions of Orange IV, an azo dye, is discussed. The results in aerated and deaerated solutions, of the addition of formaldehyde and the products formed are presented. A preprint of a paper on the radiation chemistry of methyl amine-ethane mixtures is included. The gamma ray induced oxidation of aqueous hydrochloric acid solutions of stannous ion is discussed. A study of the oxidation of ferrous chloride solutions is presented, to correlate with the mechanism of the stannous oxidation. (auth)

11701 (TID-15079) ELECTRON PARAMAGNETIC RESONANCE STUDIES OF RADIATION EFFECTS IN SOLIDS AND CHEMICAL COMPOUNDS. Technical Progress Report, June 15, 1961–March 1, 1962. Yeong Wook Kim (Wayne Univ., Detroit). Mar. 1, 1962. Contract AT(11-1)-1054. 16p.

Progress and results are reported in electron paramagnetic resonance (EPR) studies of lithium fluoride and diphenyl picryl hydrazine. Equipment needed for EPR studies at liquid He temperatures is being installed. Preliminary ultraviolet irradiation of antiferromagnetic materials is also reported. (J.R.D.)

11702 (TID-15083) THE RADIATION INDUCED EXCHANGE OF CARBON-14 BETWEEN ETHANE AND METHYL AMINE. Philip S. Lamprey and Alexander R. Amell (New Hampshire. Univ., Durham). [1961]. Contract AT(30-1)-1911. 15p.

The radioinduced exchange of C^{14} between ethane and methyl amine was studied as a function of the pressure of ethane and methyl amine, and the irradiation time. A mechanism was proposed to explain the results of the measured exchange. This mechanism includes a molecular detachment from ethane followed by a reaction with ethane, and an energy transfer between ethane and methyl amine. (auth)

11703 (TID-15123) STUDY OF DECOMPOSITION AND RECOMBINATION REACTIONS OF WATER IN THE VAPOR PHASE IN THE PRESENCE OF RADIATION. Technical Progress Report. (Minnesota. Univ., Minneapolis). [1962]. Contract AT(11-1)-1032. 14p.

Activities during the period were devoted to design, construction, and instrumentation of the experimental apparatus. Descriptions and photographs of components are included. (J.R.D.)

11704 (TID-15148) THE CHEMISTRY AND NUCLEAR CHEMISTRY OF THE HEAVY ELEMENTS. Progress Report No. 7. J. W. Cobble, ed. (Purdue Univ., Lafayette, Ind.). Feb. 1962. Contract AT(11-1)-347. 75p.

Research efforts in nuclear and physical-inorganic chemistry are reported. Progress was made on increasing the sensitivity of the microcalorimeter. Fission studies on Th^{232}, Np^{237}, and Pu^{239} were completed. Work was continued on the fission of rhenium and research was initiated on the low-energy alpha fission of rare earths. A junior cave remote facility was constructed and used in handling cyclotron targets at extreme levels of activity. (M.C.G.)

11705 (TID-15191) EFFECTS OF ATOMIC RADIATION AND OF MOLECULAR ORIENTATION ON MECHANICAL BEHAVIOR OF LINEAR SOLID HIGH POLYMERS. (Minnesota. Univ., Minneapolis. Inst. of Tech.). [nd]. Contract [AT(11-1)-532]. 13p.

Uniaxially oriented samples of polyethylene irradiated by γ-rays were investigated at room temperature. Both the tensile strength and the modulus of elasticity were found to increase as the degree of orientation induced by homogeneous stretching increased. However, the tensile strength decreased as the dose of γ-irradiation increased, while the modulus of elasticity increased. The combined effects seemed to indicate that the γ-irradiation essentially destroyed the macromolecular orientation and thus reduced the tensile strength to that of unoriented solid but with relatively higher elastic modulus. Biaxially oriented samples of polyethylene were studied for effects of γ-irradiation. It was found that again the γ-irradiation essentially destroyed the orientation of the molecular chains. However, the initial biaxial orientation was found to be more efficient in reducing the irradiation effect as compared with uniaxial orientation. The effects of biaxial prestraining and of γ-irradiation on the ultimate strength and modulus of elasticity of polyethylene are shown graphically. A previous theory was simplified and extended to analyze the effect of macromolecular orientation on the tensile strength of a branched polymer solid. The analytical result was then compared with some known experimental date for oriented polymethyl methacrylate. (auth)

11706 (TID-15204) EFFECT OF γ-IRRADIATION ON STRENGTH OF ORIENTED POLYETHYLENE. Technical Report No. 13. C. C. Hsiao and J. W. Yang (Minnesota. Univ., Minneapolis. Inst. of Tech.). Feb. 1961. Contract AT(11-1)-532. 20p.

Oriented samples of polyethylene irradiated by γ-rays were investigated at room temperature. On the basis of tensile studies both the ultimate strength and the modulus of elasticity are found to increase as the degree of orientation increases. But the ultimate strength decreases as the dose of γ-irradiation increases while the modulus of elasticity increases. The combined effects seem to indicate that the γ-irradiation essentially destroys the molecular orientation and thus reduces the ultimate strength for either uniaxially or biaxially oriented samples. (auth)

11707 (USNRDL-TR-547) EFFECT OF CURE UPON CROSSLINKING, CHAIN SCISSION, AND COMPRESSION SET IN AN IRRADIATED RUBBER VULCANIZATE. W. E. Shelberg and J. F. Pestaner (Naval Radiological Defense Lab., San Francisco). Jan. 10, 1962. 26p.

A compressed natural rubber vulcanizate was exposed to 10^9 r of gamma radiation and allowed to reach its set length at 40°C after release from compression. Compression set, crosslinking and scission of the elastomer network varied with degree of cure. (auth)

11708 (NP-tr-858) RADIATION CHEMISTRY OF HYDROCARBONS. II. BENZENE–CYCLOHEXANE. Tino Gaeumann. Translated by H. Tauber (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Helv. Chim. Acta, 44: 1337-49(1961). 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 30722.

11709 GAS CHROMATOGRAPHIC DETERMINATION OF C_2–C_{10} PRODUCTS FROM THE GAMMA IRRADIATION OF LIQUID CYCLOPENTANE. Arthur R. Lepley (Univ. of Chicago). Anal. Chem., 34: 322-5(Mar. 1962).

Fourteen C_2 to C_{10} products were identified gas chromatographically from the gamma radiolysis of liquid cyclopentane. Direct analysis of an entire irradiation sample of less than 100 mg allowed both a qualitative and a quanti-

tative determination of these products over a wide range of total gamma dosage. Use of weighed encapsulated samples and internal standards allowed a highprecision of all trace products observed in the presence of up to 10000 times their weight of cyclopentane. (auth)

11710 RADIOASSAY OF METHANETHIOL-SULFUR-35 AND METHANETHIOL-CARBON-14. Rolfe H. Herber (Rutgers Univ., New Brunswick, N. J.). Anal. Chem., 34: 340-2(Mar. 1962).

A method for the radioassay of sulfur-35-labeled methanethiol is based on the precipitation of the mercuric salt of the methyl sulfide anion when the labeled mercaptan is transferred by high vacuum gas handling techniques into an aqueous solution of mercuric cyanide. The precipitates are filtered into M-grade sintered-glass crucibles, washed with distilled water and 95% alcohol, and then dried to constant weight at 85 ± 5°C. Radioassay of the precipitates which have been prepared in layers of uniform thickness is carried out using a thin-window gas flow counter. Correction factors for the self absorption of the soft beta radiation in the samples were determined and good reproducibility of specific activity was obtained. The method is equally applicable to the radioassay of methanethiol–carbon-14. (auth)

11711 ELECTRON PARAMAGNETIC RESONANCE STUDIES ON FREE RADICALS PRODUCED BY T β-PARTICLES IN FROZEN H_2O AND D_2O MEDIA AT LIQUID NITROGEN TEMPERATURE. J. Kroh, B. C. Green, and J. W. T. Spinks (Saskatchewan Univ., Saskatoon). Can. J. Chem., 40: 413-25(Mar. 1962).

Samples of H_2O and D_2O and solutions of H_2O_2, $HClO_4$, HF, etc., in light and heavy water, were tritiated with T_2O to activities of from 0.1 to 1 c/ml. The paramagnetic resonance spectra recorded at liquid nitrogen temperature and interpreted as representing H(D) atoms and OH(OD), $HO_2(DO_2)$ free radicals were compared with those induced under analogous conditions by Co^{60} γ rays. The lower radical yields observed were ascribed to the difference in linear energy transfer between Tβ-particles and more penetrating radiations. (auth)

11712 RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS OF COBALT(III) AND NICKEL(II) AMMONIATES. A. V. Egunov and P. I. Dolin (Electrochemical Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 117-19(Jan. 1, 1962). (In Russian)

Dilute aqueous solutions of $Co(NH_3)_6Cl_3$ and $Ni(NH_3)_6Cl_2$ (5×10^{-3} moles/l) were freshly prepared, and were subjected to Cs^{137} γ-irradiation at a dose rate of 5 to 7.2×10^{15} ev/ml-sec. The irradiation of the $Ni(NH_3)_6Cl_2$ solution was carried out in a 5% ammoniacal solution to prevent the precipitation $Ni(OH)_2$. No change in the absorption spectrum of the Ni(II) solution could be detected after 48 hours of irradiation at a dose rate of 5×10^{15} ev/ml-sec. The presence of the nickel ammoniate had no effect on the yield of gaseous products which was constant at 0.310. Hence, it is concluded that nickel ammoniate in 5% NH_4OH is stable to γ-irradiation. On irradiating a neutral aqueous solution of $Co(NH_3)_6Cl_3$, the pH rises rapidly from 5.9 to 8.8, where it remains constant due to the precipitation of $Co(OH)_2$. It is believed that the Co^{3+} ion in the $[Co(NH_3)_6]^{3+}$ complex is reduced to Co^{2+}, and that the resulting $[Co(NH_3)_6]^{2+}$ complex breaks down into Co^{2+} and $6NH_3$. (TTT)

11713 ENERGY TRANSFER IN THE RADIOLYSIS OF TOLUENE CONTAINING ADDITIVES. A. T. Koritskii, V. N. Shamshev, and N. Ya. Buben (Inst. of Chemical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 142: 120-2(Jan. 1, 1962). (In Russian)

The method of electron paramagnetic resonance (EPR) was used to follow the changes in radical yields caused by the addition of small amounts of CCl_4, CS_2 and benzoyl peroxide to pure toluene. The addition of 5×10^{-4} M CCl_4 leads to an increase in yield of radicals by a factor of 4 to 5. An examination of the EPR spectrum shows the formation of both toluene radicals and of CCl_3 radicals. The total radical yield is greater than the addition yield of radicals to be expected. An addition of 5×10^{-4} M benzoyl peroxide raised the G yield by a factor of three, and an addition of 1×10^{-2} M CS_2 raised the radical yield by a factor of 5 to 6. The radicals formed from the CS_2 in the toluene could not be identified due to the complexity of the EPR spectrum. The irradiation of crystalline samples of toluene containing these same impurities gave much smaller radical yields than were obtained by irradiating amorphous samples of rapidly-frozen toluene solutions with 1.6 Mev electrons. (TTT)

11714 GRAFT COPOLYMERIZATION IN THE PRESENCE OF BENZOYL PEROXIDE-DIMETHYL ANILINE WITH THE AID OF IRRADIATION. Ágnes Somogyi, István Géczy, and János Dobó (Organic Chemical and Plastics Research Inst., Budapest and Chemical Plant Design Co., Budapest). Intern. Chem. Eng., 1: 93-9(Oct. 1961).

The extent of irradiation graft copolymerization can be increased if the monomer contains an initiator-activator and is able to swell the polymer membrane. Such is the situation in the systems: polyethylene-methyl methacrylate and polyvinyl chloride-vinyl acetate in the presence of benzoyl peroxide-dimethyl aniline. This copolymerization is dependent upon the intensity of irradiation and the concentration of the initiator-activator. Under similar experimental circumstances, vinyl acetate could not be grafted on polyethylene, while the grafting of styrene on polyethylene is but little influenced by the presence of an initiator-activator. The irradiation homopolymerization in the presence of benzoyl peroxide-dimethyl aniline is dependent upon the initiator-activator concentration, while the intensity of x-ray irradiation has only a small effect. (N.W.R.)

11715 IONIC SPECIES IN GAMMA IRRADIATED ORGANIC GLASSES AT −196°. P. S. Rao, J. R. Nash, J. P. Guarino, M. R. Ronayne, and W. H. Hamill (Univ. of Notre Dame, Ind.). J. Am. Chem. Soc., 84: 500-1(Feb. 5, 1962).

Glassed solutions of solvents, single or mixed, including tetrahydro-2-methylfuran, 3-methylpentane, isopentane, methylcyclohexane, diethyl ether, and ethanol were maintained at −196°C during Co^{60} gamma irradiation and subsequent spectrophotometry. Six significant results, observed and listed, were interpreted in the following way: free electrons are produced in condensed media with about the same $G(e^-) = 3$ as in gases; electrons are trapped and solvated in tetrahydro-2-methylfuran, and presumably other polar media, since solvent color centers photolyze to produce $C_{10}H_8^-$ in the presence of naphthalene; the color center is probably CCl_4^-; the ability of CCl_4 to suppress aromatic anion formation supports the view that it is an efficient reagent for free electrons; the phenomena of electron solvation, bleaching, and solute effects are not specific to tetrahydro-2-methylfuran but extend to ethanol and, presumably, to various other polar media; and the enhancement of $G(C_{10}H_8^-)$ in non-polar media by chemically unreactive solutes of relatively low ionization potential indicates positive hole migration and trapping. (P.C.H.)

11716 FREE RADICAL REACTIONS INITIATED BY IONIZING RADIATIONS. I. ARRHENIUS PARAMETERS

FOR THE REACTIONS OF HYDROGEN ATOMS WITH PROPANE, ETHYLENE AND PROPYLENE. Kang Yang (Continental Oil Co., Okla.). J. Am. Chem. Soc., 84: 719-21(Mar. 5, 1962).

The presence of ethylene or propylene in the gamma radiolysis of propane reduces the rate of formation of hydrogen. The extent of this inhibition depends both on radiolysis temperature and olefin concentration. This can be explained quantitatively by assuming the occurrence of the following reactions: $H + C_3H_8 \xrightarrow{k_m} H_2 + C_3H_7$, $H + C_2H_4 \xrightarrow{k_e} C_2H_5$, and $H + C_3H_6 \xrightarrow{k_p} C_3H_7$. The relative rates $k_m/k_e = 1.1 \exp(-4.4 \times 10^3/RT)$; $k_m/k_p = 1.4 \exp(-4.8 \times 10^3/RT)$; and $k_e/k_p = 1.3 \exp(-0.4 \times 10^3/RT)$ are determined based on this radical mechanism. (auth)

11717 ON THE TWO FORMS OF HYDROGEN ATOMS IN NEUTRAL SOLUTIONS IRRADIATED BY X-RAYS. Joseph Rabani (Hebrew Univ. of Jerusalem). J. Am. Chem. Soc., 84: 868-9(Mar. 5, 1962).

Bicarbonate was used as an electron scavenger in the radiolysis of neutral solutions of methanol, glucose, glycerol, and acetate. In all cases, 5×10^{-2} M bicarbonate was sufficient to reduce the hydrogen yield to about 1.05, although higher yields were obtained in some cases when no bicarbonate was used. However, in all the systems studied a constant limiting value of $G_{hydrogen} = 1.05 \pm 0.04$ was obtained. Similar results were obtained by using acetone as an electron scavenger. Using formate (0.047 M) and 2-propanol (0.01 M) about 2×10^{-4} M acetone was sufficient to reduce the hydrogen yield to about 1.1. Higher hydrogen yields obtained in the absence of an efficient electron scavenger are probably due to recombination of e_{aq} or its reaction with water. Agreement between acid and neutral k_4/k_2 values confirmed that at neutral pH the acid form of H atoms is produced by a mechanism which does not involve reactions of the neutral form of the reducing radicals in the bulk. (P.C.H.)

11718 RELATION BETWEEN ESR SPECTRA AND MOLECULAR ORIENTATION IN IRRADIATED POLYETHYLENE. Michio Kashiwagi (Toyo Rayon Co., Otsu, Japan). J. Chem. Phys., 36: 575-9(Feb. 1, 1962).

Measurements were made of the electron spin resonance spectra of irradiated polyethylene filaments with various draw ratios. The feature of the spectra is that the doublet splitting in each component of a quintet structure depends on the degree of molecular orientation in filaments. This can be ascribed to σ-proton anisotropy in alkyl radicals mainly trapped in irradiated polyethylene. From the information about CH radicals of irradiated organic crystals and the molecular orientation of polymers, the relation between the doublet splitting D and the degree of molecular orientation f is obtained as follows: $D = 13.9(1 - 0.35f)^{1/2} + 5.1(1 - 0.65f)^{1/2}$ (gauss) for the high-density polyethylene, consisting predominantly of the crystalline regions, and the spin density of the central atom of the radical is 0.70. (auth)

11719 PHOTOIONIZATION OF NITRIC OXIDE. John P. Doering and Bruce H. Mahan (Univ. of California, Berkeley). J. Chem. Phys., 36: 669-74(Feb. 1, 1962). (UCRL-9795)

The photostationary concentration of ions in gaseous nitric oxide was measured using a Langmuir probe. The ion concentration depends on the square root of the ion production rate, which indicates that ions and electrons disappear predominately by dissociative recombination. In addition, the rate of decay of the electron concentration in the gas after interruption of the ionizing radiation was measured. The data indicate that the ion-electron dissociative recombination rate constant is no greater than 2×10^{-6} cm^3/ion sec, and may be as low as 4×10^{-7} cm^3/ion sec. (auth)

11720 FLUORESCENCE ENERGY TRANSFER AND OXYGEN QUENCHING IN SOLUTIONS OF DIPHENYLOXAZOLE IN CYCLOHEXANE. Arye Weinreb (Argonne National Lab., Ill.). J. Chem. Phys., 36: 890-4(Feb. 15, 1962).

The fluorescent intensity of solutions of diphenyloxazole (PPO) in cyclohexane is measured as a function of concentration for excitation by γ rays. The fluorescence spectrum of the solutions when excited by uv is also recorded. These uv measurements, together with the results of β excitation, were used to examine the quenching influence of oxygen on the solute fluorescence and on the energy transfer from cyclohexane. The decay times of the solutions are measured. The results are interpreted to show: a tendency of PPO to form molecular complexes in cyclohexane and a static character for the oxygen quenching of cyclohexane. The dependence of transfer probability on solute concentration is discussed. (auth)

11721 FAILURE TO BOND RUPTURE AND NUCLEAR RECOIL FOLLOWING (n,γ) ACTIVATION. Adon A. Gordus and Chi-hua Hsiung (Univ. of Michigan, Ann Arbor). J. Chem. Phys., 36: 954-7(Feb. 15, 1962).

Gas-phase failures to bond rupture following $I^{127}(n,\gamma)I^{128}$, and $Br^{79}(n,\gamma)Br^{80}$ activation were found experimentally to be: CH_3I–1.09, CD_3I–0.68, CF_3I–0.12, CH_2I_2–0.068, C_2H_5I–0.082, n-C_3H_7I–0.66, i-C_3H_7I–0.30, CH_3Br–0.25, CD_3Br–0.20, CH_2Br–0.12, CF_3Br–0.11, CF_2Br_2–0.093, $CHClBr_2$–0.087, CCl_3Br–0.066, $CHBr_3$–0.05, CBr_4–0.03, C_2H_5Br–0.33, and 1,1-$C_2H_4Br_2$–0.17%. These data are correlated with calculated recoil energies required for bond rupture. Using as a basis the distribution of net gamma-ray energies calculated by the random-walk method for the $Cl^{35}(n,\gamma)Cl^{36}$ process, the kinetic-energy distributions of the dissociated I^{128} or Br^{80} are approximated. These data suggest that the extent of hot-atom reaction of I^{128} or Br^{80} with CH_4 should not depend upon the parent molecule from which the activated halogen dissociates. (auth)

11722 IONIC COMPLEXES OF Xe AND C_2H_2 PRODUCED BY THE RADIOLYSIS OF THESE GASES. P. S. Rudolph, S. C. Lind, and C. E. Melton (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 36: 1031-5(Feb. 15, 1962).

Binary mixtures of acetylene and the noble gases were irradiated by 90 ev electrons at pressures up to 1.3 mm in the ionization chamber of a research mass spectrometer. Various proportions of the mixtures and a range of pressures were employed in the study. Ionic complexes, $[XeC_2H]^+$ and $[XeC_2H_2]^+$, were observed in the C_2H_2–Xe system. The intensity ratio $[XeC_2H_2]^+/[XeC_2H]^+$ increased linearly with increasing pressure. No ionic complexes were observed in the other mixtures. A series of reactions involving Xe^+ is presented. (auth)

11723 ELECTRON SPIN RESONANCE OF IRRADIATED ETHYL BROMIDE. F. W. Mitchell, B. C. Green, and J. W. T. Spinks (Univ. of Saskatchewan, Saskatoon, Can.). J. Chem. Phys., 36: 1095-6(Feb. 15, 1962).

The electron spin resonance derivative trace of irradiated polycrystalline ethyl bromide is shown. There is a lack of total symmetry in its appearance and in its distribution about the free spin value; there being much extra structure on the low field side. The trace is also very broad, the total width being approximately 400 gauss. The integrated absorption curve is also shown and evaluated. (P.C.H.)

11724 ELECTRON SPIN RESONANCE STUDY OF γ-IRRADIATED SINGLE CRYSTALS OF dl-ISOVALINE. Thadho S. Jaseja (Univ. of Maryland, College Park) and

Roy S. Anderson. J. Chem. Phys., 36: 1098-9(Feb. 15, 1962).

Single crystals of dl-isovaline were initially exposed at room temperature to x irradiation and the ESR examined. Only a weak ESR signal was observed. However, room temperature exposure of the crystal to 6.3×10^6 r of γ radiation resulted in an intense, stable ESR spectrum. By taking ESR spectra at several orientations of the crystal in the magnetic field, it was determined that more than one radical site exists in the unit cell. Interpretation of the spectra indicates that irradiation results in the abstraction of the NH_2 group from the molecule, leaving a stable radical product. Isotropic hyperfine splittings of 65 ± 3 Mc resulting from each of the protons in the methyl group bonded to the carbon atom on which the unpaired electron is principally localized is also indicated. Slightly anisotropic hyperfine interactions were associated with the methylene protons. (P.C.H.)

11725 THE PREPARATION OF SOME ISOTOPICALLY LABELLED NITROSOALKANES. L. Batt, J. K. Brown, B. G. Gowenlock, and K. E. Thomas (The University, Birmingham, Eng.). J. Chem. Soc., 37-40(Jan. 1962).

Dimers (cis- and trans-) of deuterated nitrosomethane were prepared by the pyrolysis of deuterated isopropyl nitrite, and cis- and trans-dimers of [N^{15}]nitrosomethane and -nitrosoethane by the reaction ob pyrolytically generated methyl and ethyl radicals with [N^{15}]nitric oxide. The infrared absorption frequencies of the compounds are listed. (auth)

11726 FORMATION OF STEREOSPECIFIC $DO_2C \cdot CHD \cdot CH \cdot CO_2D$ ON IRRADIATION OF OO'-DIDEUTERIOSUCCINIC ACID. D. Pooley and D. H. Whiffen (The University, Birmingham, Eng. National Physical Lab., Teddington, Middx, Eng.). J. Chem. Soc., 366-7(Jan. 1962).

A single crystal of OO'-dideuteriosuccinic acid was prepared and irradiated with Co^{60} gamma rays. The spectrum showed that the radical $DO_2C \cdot \dot{C}H_2 \cdot CH \cdot CO_2D$ was formed along with additional lines attributed to $DO_2C \cdot CHD \cdot \dot{C}H \cdot CO_2D$ or its O-hydrogen analogues. The $DO_2C \cdot CHD \cdot \dot{C}H \cdot CO_2D/DO_2C \cdot CH_2 \cdot \dot{C}H \cdot CO_2D$ ratio remained about 1:3 no matter whether the crystal was grown in 1 hour or in two days. Refluxing the acid in D_2O for any length of time up to 10 days at pH's from 1 to 13 led to the same spectra. The most remarkable feature of the electron resonance spectra is the absence of any line which could be attributed to $DO_2C \cdot CH_2 \cdot CD \cdot CO_2D$ or to an isomeric form of $DO_2C \cdot CHD \cdot \dot{C}H \cdot CO_2D$. The stereospecificity of the formation of $DO_2C \cdot CHD \cdot \dot{C}H \cdot CO_2D$ is puzzling since it must form rapidly below room temperature and is probably without appreciable activation energy. (P.C.H.)

11727 THE SIGNIFICANCE OF PREPARATIVE RADIOCHEMISTRY FOR THE APPLICATION OF RADIONUCLIDES IN RESEARCH AND INDUSTRY. H. J. Born (Technische Hochschule, Munich). Kerntechnik, 3: 515-18 (Dec. 1961). (In German)

If a radionuclide is to be used in research and industry, it must first be produced physically and then processed chemically in order to achieve the following goals: pure separation of the nuclide desired, improvement of the specific activity, transformation into a form suitable for the application, and blending, if necessary, into a given chemical compound. Several examples show how progress in the chemical preparative work can open new fields of application. (auth)

11728 THE MEASUREMENT OF TRITIUM AND C^{14}. K. H. Waechter (Frieske & Hoepfner G.m.b.H., Erlangen-Bruck, Ger.). Kerntechnik, 3: 527-9(Dec. 1961). (In German)

The usual methods for measuring tritium and radiocarbon are compared. Unfortunately the measurement of soft betas emitted from solids is possible only with small sensitivity. Measurement with internal counters and chambers or with the aid of liquid scintillators is preferable. Tables which compare characteristic values of the different methods are compiled. (auth)

11729 THE IMPORTANCE OF HYDROGEN ATOM REACTIONS IN RADIOLYSIS. Yu. N. Molin (Inst. of Chemical Physics, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 490-1(July-Aug. 1961). (In Russian)

Reactions of labeled and normal hydrogen atoms in liquid- and solid-phase radiolysis are analyzed. (tr-auth)

11730 ESR SPECTRUM OF ETHYL RADICALS ADSORBED OF SILICAGEL. V. B. Kazanskii and G. B. Pariiskii (Inst. of Physical Chemistry, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 507-8(July-Aug. 1961). (In Russian)

The paramagnetic resonance spectrum of free ethyl radicals formed during γ irradiation of ethane adsorbed on silicagels at 196°C was investigated. (R.V.J.)

11731 APPARATUS FOR STUDYING HETEROGENEOUS CATALYSIS AT HIGH TEMPERATURES, USING RADIOACTIVE CATALYSTS AND THE IONIZING RADIATION. A. A. Balandin, V. I. Spitsyn, A. P. Rudenko, N. P. Dobrosel'skaya, I. E. Mikhailenko, G. I. Pirogova, and P. Ya. Glazunov (Moscow State Univ.). Kinetika i Kataliz, 2: 626-32(July-Aug. 1961). (In Russian)

A method was developed for studying heterogenic-calalytic vapor-phase processes under atmospheric conditions using a radioactive catalyst and external radiation. The apparatus consists of a quartz catalytic device with an inserted reactor for operations with solid radioactive catalyst and external β or γ radiation; a dosimetric system; and a remote-control system. A system for automatic thermal control, based on a specially constructed electric furnace with open tubular heating elements, was also included. (tr-auth)

11732 THE PREPARATION OF MEDICAL APPLICATORS WITH DIFFERENT ISOTOPES ON THE BASIS OF ION-EXCHANGE MATERIALS. V. A. Sokolov and T. I. Kondrat'eva. Med. Radiol., 7: No. 1, 28-32(Jan. 1962). (In Russian)

The possibility of using certain ion-exchange materials for obtaining sources and applicators with different emitters for medical use was investigated. It was found that heterogeneous and homogeneous membranes and films, endowed with a high ion-absorption capacity, are very convenient materials for preparing applicators and sources. The technological process is described and the results of experiments with prepared radiophosphorus and other radioisotopes are given. (auth)

11733 RADIATION THERMAL CRACKING OF PETROLEUM FRACTIONS. A. M. Brodskii, N. V. Zvonov, K. P. Lavrovskii, and V. B. Titov. Neftekhimiya, 1: 370-81 (May-June 1961).

An experimental study of radiation thermal cracking was carried out with 200 to 350° and 190 to 325° kerosene-gas oil fractions in the liquid phase at temperatures ranging from 300 to 400°C in a radiation field of a water-moderated reactor. The fractions were studied under static conditions in order to determine the basic mechanism of radiation thermal cracking. The results were verified under dynamic conditions on a circulation loop located in an experimental

hole of the reactor. It was determined that the conversion of liquid hydrocarbons proceeds in three stages: pure radiolysis, radiation thermal cracking, and regular thermal cracking. In pure radiolysis the conversion rate below the 310 to 330°C range changes only slightly with rise in temperature and the predominant processes are those of recombination of radicals formed under the effect of radiation. In radiation thermal cracking the conversion sets in at ~310°C with an abrupt change in the rate and direction of the radiation thermal cracking indicated by a change in the radiochemical yields and the composition of the gases and high-boiling residues. Destructive processes, similar to those taking place in thermal cracking, play an important role in the 310 to 330°C range. Rapid decomposition of radicals with rupture of C–C bonds, indicated by an increase of methane and a decrease of hydrogen content in the gaseous radiolysis products, occurs above 330°C. With a further rise in temperature, radiation thermal cracking changes gradually to regular thermal cracking. It is concluded that radiation thermal cracking effects greater conversion of the raw material than pure radiolysis and that the relationships between the chemical processes are quite different from those in regular thermal cracking. (OTS)

11734 THE SEPARATION OF ZINC, MANGANESE, AND COBALT FROM IRON BY REVERSED-PHASE CHROMATOGRAPHY. Jan Mikulski and Ignacy Stroński (Inst. of Nuclear Physics, Polish Academy of Sciences, Krakow). Nukleonika, 6: 295-8(1961). (In English)

The separation of bivalent cations of zinc, manganese, and cobalt from the trivalent cation of iron in 9N HCl solutions is reported. These experiments were undertaken as a continuation of research on new methods leading to the preparation of carrier-free radioisotopes for nuclear spectroscopy purposes from targets irradiated by deuterons in a cyclotron. (auth)

11735 DISTRIBUTION OF MICROQUANTITIES OF RADIOACTIVE Sr BETWEEN HYDRATED OXIDES AND SOLUTION. Yu. V. Egorov, E. I. Krylov, and E. V. Tkachenko. Radiokhimiya, 3: 654-61(1961). (In Russian)

The sorption of microquantities of radioactive isotopes by hydrated oxides, which act as cations in hydrogen, is investigated. An analytical expression for the sorption-pH relation was found, and the sorption of strontium by active manganese dioxide and iron hydroxide was confirmed. It is also shown that the Panet-Fayans rule holds for strontium sorption by iron hydroxide and active manganese dioxide when the hydrated oxides are considered as weakly acid compounds. (R.V.J.)

11736 SEPARATION OF RADIOACTIVE ISOTOPES BY FREEZING. V. V. Vol'khin and V. L. Zolotavin. Radiokhimiya, 3: 719-23(1961). (In Russian)

The effects of freezing on Cr^{51}, Fe^{59}, Nb^{95}, and Zr^{95} separation from hydroxide solutions with isotopic carrier concentrations 10^{-5}, 10^{-8}, and $\sim 10^{-11}$ M were studied. Following freezing and thawing the following amount of radioactive isotopes precipitate during 12 hours: 93 to 98% for a carrier concentration of 10^{-5} M; 65 to 85% for 10^{-8} M; and 55 to 70 for 10^{-11} M. An additional separation can be achieved by centrifuging the solution. An average concentration of neutral salts does not influence the precipitation. Freezing offers a means for colloidal precipitation without a coagulating agent. (R.V.J.)

11737 SEPARATION OF IRRADIATED SAMARIUM FROM RADIOACTIVE RARE EARTH ELEMENTS BY ELECTROLYSIS WITH MERCURY CATHODE. A. K. Lavrukhina, G. M. Kolesov, and Hsiao-en T'ang. Radiokhimiya, 3: 724-31(1961). (In Russian)

The effects of cathode current density, length of electrolysis, concentration of samarium, and the properties of the alkali metal on samarium yield at a mercury cathode were studied, and optimum conditions for quantitative Sm (up 99.7%) separation (within one hour) were found. The transport of Pm and Ce at high current densities (<75 μ/cm^2) was also analyzed. (R.V.J.)

11738 ELECTRON IMPACT ON SOME HALOGENATED AROMATIC COMPOUNDS. J. R. Majer and C. R. Patrick (Univ. of Birmingham, Eng.). Trans. Faraday Soc., 58: 17-22(Jan. 1962).

Appearance potentials of the phenyl radical ion from the halobenzenes were measured. It is shown by considering the apparent heats of formation of these radical ions that the accepted value of the ionization potential of the phenyl radical is too great. Assuming the accepted value for the heat of formation of the phenyl radical, the ionization potential should be about 9.4 ev or less. Ionization potentials of, and appearance potentials of the substituted phenyl radicals from some polyfluorobenzenes are reported. Significance of the values obtained is discussed, but the absence of thermochemical data relating to these compounds prevents a detailed analysis of the appearance potentials. (auth)

11739 THE RADIATION-INDUCED POLYMERIZATION OF α-METHYLSTYRENE. J. V. F. Best, T. H. Bates, and T. Ffrancon Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Faraday Soc., 58: 192-205(Jan. 1962).

A kinetic study of the polymerization of α-methylstyrene initiated by cobalt-60 gamma rays is described. Using dry monomer at 30°C, the mean initial yield corresponds to the conversion of 8000 molecules per 100 ev; the rate accelerates with increasing polymer formation and the polymerization proceeds almost to completion. A decrease in dose rate brings about a higher rate of polymerization per unit dose. At 0 to 30°C, there is a slight increase of rate as the temperature is lowered; at 55°C the rate is considerably reduced. The addition of water in concentrations above 0.002 M to the system results in a very strong retardation of the rate by comparison with the dry reaction. While the molecular weight of the polymer depends on the extent of monomer conversion, with M_n between 1900 and 5100, it is only slightly affected by the presence of water in the polymerizing medium. The occurrence of facile chain transfer to monomer and the marked effect of water on the reaction rate are interpreted as evidence in favor of an ionic mechanism. It is proposed that water interferes mainly in the primary act leading to a suppression of the ionic initiator before propagation can ensue. (auth)

11740 CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS. VOL. II. PROCEEDINGS OF THE SYMPOSIUM ON CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS, HELD IN PRAGUE, 24-27 OCTOBER 1960. (International Atomic Energy Agency, Vienna). Proceedings Series. Nov. 1961. 398p. (STI/PUB/34(Vol. II)). $7.00(IAEA).

Thirty-five papers are included; separate abstracts were prepared for 33; 2 papers on chemical transformations associated with the nuclear reaction $N^{14}(n,p)C^{14}$ in nitrogenated organic heterocyclic molecules and the separation of fission products by recoil were previously abstracted in NSA. 24 of the papers are in English, 1 in French, and 8 in Russian. However, English, French, Russian, and Spanish

abstracts are given for each paper. A separate author index is included along with a list of the participants. (P.C.H.)

11741 REPLACEMENT EVENTS RESULTING FROM THE $N^{14}(n,p)C^{14}$ REACTION IN ORGANIC SYSTEMS: STATISTICAL CONSIDERATIONS AND ISOTOPE DISTRIBUTIONS. A. P. Wolf (Brookhaven National Lab., Upton, N. Y.). p.3-15 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (BNL-4891). (In English)

The statistical nature of replacement processes is analyzed in four contexts: the relation of the replacement of hydrogen by C^{14} with respect to the number of replaceable hydrogens: the systems pentane-hexane and toluene-xylene are discussed; the effect observed on the radiochemical yield of a hydrogen-rich product as a function of varying hydrogen availability during irradiation: data on the system benzene-toluene are presented; the replacement by C^{14} of atoms of comparable mass: numerous systems including acridine, aniline, and nicotinic acid are considered; and the relation between isotope distribution in the labelled molecule and the nature of the displaced atom: hydrocarbons (aromatic and aliphatic), alcohols, amines and other classes of compounds are used in illustration. The possible relation of these data to mechanisms and energy considerations is explored. (auth)

11742 THE ELEMENTARY CHEMISTRY OF ATOMIC CARBON. C. MacKay, M. Pandow, P. Polak, and R. Wolfgang (Yale Univ., New Haven and Haverford Coll., Penna.). p.17-26 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

The reactions of carbon atoms with a number of gaseous molecules were studied. Discussion is given on a new technique using 20.5-min C^{11} produced by a neutron stripping reaction of C^{12}. This method permits a reduction of radiation dosage to 10^{-2} ev per molecule. Carbon atom reactions with a wide variety of simple oxidizing agents were investigated, among them air, O_2, O_2-O_3 mixtures, CO, CO_2, NO, NO_2, N_2O, and SO_2. CO is always the major product, accounting for up to 98% of volatile products, with the diatomic molecules. Minor specific products, such as C_3O_2 from CO, and COS from SO_2 are occasionally observed. Reactions with hydrogen and ammonia to give methane seem to proceed with greater difficulty. With hydrogen, half the carbon atoms appear as methane and half as CO, although the only sources of oxygen are trace impurities and the wall. With ammonia essentially no methane is formed. In both systems addition of oxygen substantially increases CO-recovery. With propane and propylene several unsaturated primary products are formed, but little methane. Acetylene and ethylene are the major products. This is believed to result from multiple bond rupture in a highly excited reaction intermediate. C_3 unsaturated molecules are also produced. These may arise from carbon atom insertion into C-H and C-C bonds. (auth)

11743 REACTIONS OF ACCELERATED $^{14}C^+$ IONS WITH BENZENE. R. M. Lemmon, R. T. Mullen, and F. L. Reynolds (Univ. of California, Berkeley). p.27-35 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (UCRL-9397). (In English)

An isotope separator, constructed for the specific purpose of irradiating organic compounds with accelerated carbon ions is described. The instrument has a capillary-arc ion source and uses either $C^{14}O_2$, $C^{14}O$, or $C^{14}H_4$ as the source gas. Depending on the source gas used, the accelerated ions may be singly charged C^{14}, CH^{14}, CH_2^{14}, or CH_3^{14}. The instrument is so constructed that the energy of the impinging ions may be varied from a few electron volts to about six kilovolts. From $C^{14}O_2$, the isotope separator provides a beam of C^{14} ions of approximately one microampere. Research work done with such a beam is described. The systematic degradation of labelled toluene formed by the C^{14} irradiation of benzene was studied, and the results of this degradation are presented and discussed. (auth)

11744 HOT-ATOM CHEMISTRY OF C^{14} IN SOLID ORGANIC COMPOUNDS. F. Cacace, G. Giacomello, and M. Zifferero (Università, Rome). p.51-5 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Chemical reactivity of recoiling radiocarbon atoms was investigated in simple solid organic compounds of alkyl phenyl ethers irradiated with thermal neutrons. Radiocarbon distribution in the resulting radioactive molecules is discussed on the basis of a simple reaction mechanism. (auth)

11745 CHEMICAL EFFECTS OF THE $C^{12}(\gamma,n)C^{11}$ REACTION. K. J. McCallum and W. J. Edwards (Univ. of Saskatchewan, Saskatoon, Can.). p. 57-62 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

The chemical effects of the $C^{12}(\gamma,n)C^{11}$ reaction in sodium formate were studied. Irradiations of the solid were made using the bremsstrahlung from a betatron operating at 23 Mev peak energy. The solid was dissolved in aqueous solutions, and the products containing the C^{11} were isolated and measured by carrier techniques. The products were carbon monoxide, 5%, carbon dioxide, 4%, formic acid, 15%, oxalic acid, 6%, glyoxylic acid, 11%, glycolic acid, 31%, glyoxal, 15%, and glycolaldehyde, 14%. The effect of thermal annealing at 315°C was to increase the amount of radioactive carbon dioxide, formic acid, and oxalic acid. In addition, a small amount of ethylene glycol appears to be formed. The experimental results are compared with those obtained on the irradiation and annealing of carbonates. With irradiated carbonates, thermal annealing produces a product in the plus four oxidation state. With sodium formate (plus two oxidation state), annealing produces products in the plus two or plus four state, or a combination of these (oxalic acid). Possible mechanisms are considered. (auth)

11746 THE REACTIONS OF HIGH-KINETIC-ENERGY TRITIUM ATOMS FROM NUCLEAR RECOIL. F. S. Rowland, J. K. Lee, B. Musgrave, and R. M. White (Univ. of Kansas, Lawrence). p.67-81 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Gas phase recoil tritium reactions are discussed in a number of systems in order to illustrate some general and specific characteristics of hot reactions. Those systems include: general product distributions in several hydrocarbons; competition between saturated and unsaturated positions, both intramolecularly and intermolecularly, with alkenes; isotope effects in reactions with $H_2 + D_2$, $CH_4 + CD_4$, and CH_2D_2; and sensitivity to secondary radioinduced reactions, and substitution in a readily isomerized molecule, with cyclopropane. Reactions carried out in crystalline solids are used to illustrate the solid phase reactions of recoil tritium with: asymmetric carbon atoms in L(+)-alanine; ortho-meta-para competition in benzoic and cinnamic acids; and various substituent groups in substituted benzoic acids in which bond energy effects are very noticeable. (auth)

11747 ON THE CHEMISTRY OF RECOIL TRITIUM. M. Henchman, D. Urch, and R. Wolfgang (Yale Univ., New Haven). p.83-98 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

A review is given on the method, kinetic theory, systematics, and mechanism of recoil tritium reactions. The kinetic theory has been developed and quantitatively verified by the reactions of recoil tritium with methane in the presence of rare gas moderators. With the kinetic basis of the nature of hot-atom reactions thus clarified for recoil tritium, several experiments performed to shed light on the detailed mechanism of hot atom reactions are discussed. Observations made from these experiments are also discussed and evaluated. (P.C.H.)

11748 THE REACTIONS OF HOT HYDROGEN ATOMS WITH ALKENES. D. Urch and R. Wolfgang (Yale Univ., New Haven). p.99-107 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Recoil hydrogen atoms, made by the $He^3(n,p)H^3$ process, reacted efficiently with alkenes to form $H^1 \cdot H^3$, labelled parent alkene and specific labelled alkenes, in the presence of oxygen as a scavenger for radicals. These reactions must therefore be rapid, non-radical, and hot. Rearranged products are rare, thus indicating that ions are not important. About 70% of the observed tritium was found as $H^1 \cdot H^3$ or as labelled parent alkene, but 20–25% was found in a few smaller alkenes which formed a specific pattern, characteristic of the parent alkene. The yields of these alkenes were an order of magnitude greater than the yields of other fragment molecules from either alkenes or alkanes. It is postulated that the $H^1 \cdot H^3$ derives mainly from hot hydrogen attack in line with the C—H bond and the labelled parent molecule is formed by attack normal to the bond with displacement and replacement of the hydrogen atom. A model proposed for the formation of these products from alkanes may be extended with success to alkenes. The following mechanism is proposed for the formation of the high yield fragment alkenes. A hot hydrogen atom adds to the double bond of an alkene to form an excited radical. This radical decomposes quickly ($<10^{-7}$ sec) without rearrangement by cleaving one of its weakest bonds to form a smaller radical and a labelled alkene. Results are presented for alkenes from C_2 through C_6 (including branched molecules) in which the pattern of major alkene fragments is in accord with the proposed mechanism. The presence of oxygen in a few experiments did not affect the results, showing that the intermediate radical has a short life and is derived from non-thermal tritium atoms. (auth)

11749 GAS-CHROMATOGRAPHIC STUDIES ON THE DISTRIBUTION OF TRITIUM IN LABELLED TOLUENE. H. J. Ache, W. Herr, and A. Thiemann (Max-Planck-Institut für Chemie, Mainz; Universität, Cologne; and Kernforschungsanlage, Jülich, Ger.). p.111-21 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

The distribution of tritium in tritiated toluene was measured by preparing appropriate nitro-derivates. These were separated on gas-chromatographic columns. The substances were identified by thermal conductivity measurements, simultaneously the H^3 activity was recorded by a gas counter. For the high-boiling substances it was necessary to run the gas chromatograph and the counter at temperatures up to 220°C. In consequence considerable analytical difficulties had to be overcome. It was found that the addition of nitrobenzene to the counting gas, which consisted of helium and methane, proved to be especially useful. The results of various labelling methods are compared and discussed in the light of current research. (auth)

11750 THE REACTIONS OF RECOIL-TRITIUM(II), THE SITES OF INTERACTION IN PHENYLACETIC ACID. A. M. Elatrash and R. H. Johnsen (Florida State Univ., Tallahassee). p.123-32 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Studies were made to ascertain what factors, if any other than chance, determine the final location of a recoiling tritium atom in a fairly complex molecule. To this end the specific site of interaction in phenylacetic acid, a substance having both an aromatic nucleus and a aliphatic side chain, was determined. A study of the percentage-entry in the parent, a complete degradation study, and an investigation of important decomposition products was made. About 30% of the calculated amount of tritium was found to reside ultimately in the intact parent in non-labile positions and 8% in the labile position. Nine per cent was found as toluene and 3% as benzene. The activity at the ends of the molecule is somewhat above the average, but the equally exposed methylene group contains a surprisingly small fraction of the total activity. It is believed that this is due to post-labelling decomposition of the excited molecule rather than directive or selective factors. Such a view is supported by the large amounts of labelled toluene and benzene observed. If a hypothetical distribution before dissociation is calculated by assigning the toluene activity to the methylene position a distribution is obtained which suggests very strongly that interaction takes place on an essentially random basis with perhaps some slight steric influence. The non-uniform distribution is, however, largely due to the extraordinary sensitivity toward decomposition when labelling occurs at the position adjacent to the carboxyl group, resulting in a highly excited molecule. It is conjectured that, in general, apparently selective labelling previously observed is actually due to this type of selective decomposition. It is further conjectured that selective decomposition may be useful as a means of producing specifically rather than the randomly labelled substances which are the usual products of recoil labelling. (auth)

11751 THE DISTRIBUTION OF RADIOACTIVE ATOMS IN AROMATIC MOLECULES LABELLED BY EXPOSURE TO TRITIUM GAS. F. Cacace (Università, Rome). p.133-41 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

The tracer atoms distribution in aromatic molecules, such as toluene, phenol, chlorobenzene, nitrobenzene, anisole, and ethyl benzoate labelled by exposure to tritium gas, was determined. The possible mechanisms of the exchange process, including recoil of tritium atoms after beta decay and reactions of excited or ionized molecules, were examined. (auth)

11752 A STUDY OF ISOTOPE EFFECTS IN BETA-DECAY OF NATURAL ISOTOPES OF LEAD. V. D. Nefedov, Nefedov, Yu. A. Ryukhin, M. A. Toropova, V. N. Mel'nikov, and Chih-min Li (Academy of Sciences, Moscow). p.149-55 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In Russian)

A study was made of isotope effects in the beta decay of Pb^{210} and Pb^{212}. The isotope effects were detected and studied by observing the distribution of different isotopes of the daughter element among specific chemical forms. The initial parent substance used in the work was $PbPh_3Cl$. The

daughter forms were accumulated in crystals of this compound. $BiPh_3Cl_2$ and inorganic Bi^{3+} were selected for study (the daughter forms, in which the distribution of bismuth isotopes was investigated). The results of the study of distribution of bismuth isotopes between $BiPh_3Cl_2$ and the inorganic form were obtained with the parent substance $PbPh_3Cl$ labelled with Pb^{210}, Pb^{212}, and with both isotopes together, and they showed that the difference in chemical behavior of the bismuth isotopes observed in these experiments cannot be related to any other factor but the difference in the decay schemes of the parent isotopes. In the case of heavy nuclei with low-energy beta radiation one of the most important factors determining the chemical state of the daughter atoms is the magnitude of the internal conversion coefficient. The existence of daughter atoms in the form of organic derivatives depends mainly on two processes: survival of the parent molecules and recombination of fragments. (auth)

11753 THE EFFECT OF THE RECOIL ENERGY OF NUCLEAR TRANSFORMATIONS IN SOLIDS ON THE SEPARATION OF NATURAL RADIOISOTOPES. K. B. Zaborenko and A. M. Babeshkin (Moscow State Univ.). p.157-67 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In Russian)

The behavior of radioisotopes in minerals, and the mechanism of the processes determining the chemical state and distribution of radioelements in the crystal lattice of minerals were studied. Because of the difficulties in working with natural minerals, investigations were carried out on artificial compounds, imitations of natural radioactive minerals. By means of isomorphous co-precipitation, barium salts, soluble only with difficulty, containing Ra^{228} and Ra^{226} were obtained, and by the following radioactive decay scheme: $Ra^{228} \xrightarrow{\beta} Ac^{228} \xrightarrow{\beta} Th^{228} \xrightarrow{\alpha} Ra^{224} \xrightarrow{\alpha} Rn^{220} \xrightarrow{\alpha}$, daughter products, including Ra^{224} and Rn^{220}, were accumulated in the initial compounds. On the basis of these isotopes the general extraction and distribution mechanisms of recoil atoms in solid, powdered substances was studied. It was established that the chemical state of a radium isotope formed in barium salts as a result of radioactive transformations is not distinguishable from the chemical state of a radium isotope introduced into the crystal lattice of the salt while the latter is being prepared. It is shown that in the interaction of the barium salts with aqueous solutions the separation of the barium isotopes is connected with the emission of recoil atoms, and that the quantitative relations for radium in solutions depend on the magnitude of the intervals between the salt particles and the amount of the solid phase that enters into the exchange. However, the recoil-atom fraction of the inert gas Rn^{220} depends, not on the size of the intervals, but on the magnitude of the surface of the solid-matter particles and by the quantity of Ra^{224} recoil atoms that fall into the interstitial spaces. (auth)

11754 SOME NOVEL, DECAY-INDUCED INORGANIC SPECIES. D. Baulch, J. Duncan, and F. Thomas (Univ. of Melbourne). p.169-81 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Discussion is given on nuclear recoil, excitation of the extranuclear electrons, and thermodynamic effects in nuclear beta decay. A system in which recoil effects exert the major influence, despite the small recoil energies involved (~3 ev), consists of radioactive lead isotopes adsorbed on a solid surface. Beta decay of the lead results in the ejection of a certain fraction of the daughter bismuth atoms from the surface. Recent experimental investigation of this system using Pb^{212} and Pb^{214} shows that such ejection may be described quantitatively in terms of the recoil process alone and hence the method may be used as a means of determination of surface binding-energies. (auth)

11755 USE OF THE CHEMICAL CHANGES ACCOMPANYING BETA-DECAY OF RaE FOR THE SYNTHESIS OF ORGANIC COMPOUNDS OF POLONIUM. A. N. Murin, V. D. Nefedov, V. M. Zaitsev, and S. A. Grachev (Academy of Sciences, Moscow). p.183-7 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In Russian)

New methods of synthesizing previously unknown organic compounds of polonium were developed. One method of effective synthesis is that based on the utilization of the chemical changes accompanying beta-decay processes. A method of this type was employed to obtain various organic compounds of polonium. For this purpose several organic compounds containing RaE were used, in which, after beta decay of the RaE, organic compounds of polonium were formed (RaF). The polonium produced by beta decay of the RaE accumulated in crystals of $Bi(RaE)Ph_3$ and $Bi(RaE)Ph_3Cl_2$. The polonium daughter products (RaF) were identified by paper chromatography using ethyl acetate, carbon tetrachloride, and petroleum ether as solvents. In the case of polonium accumulated in crystals of $Bi(RaE)Ph_3Cl_2$ no $PoPh_3$ was found and almost all the polonium ($92 \pm 3\%$) in this case was found in the form $PoPh_3Cl_2$. (auth)

11756 AN INVESTIGATION OF THE CHEMICAL STATE OF RADIOPHOSPHORUS IN KCl CRYSTALS IRRADIATED WITH HIGH-ENERGY PROTONS. A. N. Murin, S. N. Banasevich, and R. V. Bagdanov (Academy of Sciences, Moscow). p.191-9 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In Russian)

The forms in which radiophosphorus exists in alkaline colloidal crystals and the chemical transformations it undergoes were studied. The targets used were monocrystals of KCl which had been heated to 650–700°. A 660 Mev proton beam was used, with an integral flux of $10^{12}-10^{13}$ protons/cm^2 of target throughout the irradiation. In the irradiated KCl crystals phosphorus was found in all three valency forms—phosphate, phosphite, and hypophosphite. It was noted that crystals of KCl subjected to high-temperature annealing before irradiation contained 10–20% of the P^{32} activity in the phosphate fraction, but that in crystals not so treated the contribution of this fraction rose to 50–60%. Heating of the irradiated samples at different temperatures for a period of 2 hours showed that the rate of transition to the pentavalent state increases with temperature. The experiments performed in order to detect atomic phosphorus gave a negative result. On the basis of the results obtained in the work a tentative explanation is given of the reactions taking place in the irradiated crystal and the different valency states of the phosphorus obtained. (auth)

11757 SOME CHEMICAL CONSEQUENCES OF NUCLEAR TRANSFORMATIONS PRODUCING SULPHUR ACTIVITIES. R. H. Herber (Rutgers Univ., New Brunswick, N. J.). p.201-8 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

The chemical fate of 87.1-d S^{35} produced by the $Cl^{37}(\alpha,\alpha pn)$, $Cl^{35}(\alpha,3pn)$, and $Cl^{37}(p,2pn)$ reaction, and 172-min S^{38} produced by the $Cl^{37}(\alpha,3p)$ reaction was studied with the aid of 300 Mev alpha-particles and 550 and 680

Mev protons. In NH_4Cl solid targets, an appreciable fraction of the total sulfur activity was found to be in a non-sulfate form when appropriate aqueous carrier techniques were used to fractionate S(VI) from lower oxidation states. There does not appear to be any significant dependence of the final chemical fate of the sulfur activity on the initial recoil energy of the sulfur atom. Good agreement was obtained for the fraction of sulfate and non-sulfate activity due to the S^{38} and S^{35} produced in alpha-particle-irradiated targets. If $NaClO_4$ is exposed to 300 Mev alpha-particles, essentially all (more than 98%) of the activity appears in the sulfate form. This observation is in agreement with the S^{35}-distribution in slow (0.025 ev) neutron-irradiated $NaClO_4$ which had been molten and evacuated before irradiation, as well as with the S^{35}-distribution in slow-neutron-irradiated KCl which had not been pre-treated before irradiation. A non-aqueous scavenging technique employing SO_2, COS, and CS_2 scavengers in the analysis of slow-neutron-irradiated KCl which had not been outgassed before irradiation indicated that only the S(VI) fraction carried any of the S^{35} activity. (auth)

11758 THE CHEMICAL EFFECT OF THE (n,p) REACTION: NEUTRON-IRRADIATION OF THE CHLOROBENZENE–BENZENE SYSTEM. K. Panek and L. Slama (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). p.209-11 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In Russian)

Reactions of hot S^{35} atoms in benzene were studied. Hot S^{35} atoms were generated by the reaction of thermal neutrons in the $Cl^{35}(n,p)S^{35}$ process. Chlorobenzene was used as a source of chlorine. The distribution of the radiosulfur activities produced was studied. Most of the activity was found to be in polymeric compounds. Among the wide variety of compounds formed, thiophenol-S^{35} was identified. No activity was found in the gaseous fraction. (auth)

11759 THE CHEMISTRY OF N^{13}-RECOILS IN SOME CARBON COMPOUNDS. W. S. Koski, H. Schmied, and W. C. Perkins (Johns Hopkins Univ., Baltimore). p.217-21 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

The chemistry of N^{13}-recoils produced by the $C^{12}(d,n)N^{13}$ reaction in methyl bromide, methyl chloride, chloroform, and carbon tetrachloride was studied. A combination of gas-chromatographic and chemical methods was used to analyze the different reaction products. The main product in the CH_3Br and CH_3Cl cases was HCN. In $HCCl_3$, ClCN was found in addition to HCN. In carbon tetrachloride ClCN was the main product. In addition, three other radioactive compounds were observed. Nitrogen, NO_2, and one other unidentified nitrogen–oxygen compound were detected. These latter compounds probably arise from the reactions of N^{13} with nitrogen and oxygen which were originally adsorbed on the surface of the reaction vessel. No significant amounts of NH_3 were detected, indicating that probably no abstraction of hydrogen takes place. In methyl, ethyl, and propyl alcohols, N^{13} recoils yield HCN and CH_3CN as the main products in addition to radioactive nitrogen and nitrogen oxides plus traces of ethyl and propyl cyanide. The nature of the surface appears to play a significant role in the process since, if metal cells are used, the production of HCN is suppressed considerably, whereas the amount of CH_3CN is not affected significantly. In glass cells, the HCN peak is stronger than the CH_3CN peak. In all experiments, conditions were chosen so as to keep radiation damage to a minimum. Preliminary attempts have been made to stimulate the above reactions by producing nitrogen ions in an RF ion source, accelerating them to about 50 kev and then permitting them to bombard solid methyl alcohol targets. The products produced were analyzed by high-sensitivity gas-chromatography methods. The presence of methyl cyanide in addition to other products was readily detected. (auth)

11760 THE CHEMICAL STATE OF I^{131} FROM Te^{131}-LABELLED DIBENZYL TELLURIDE. A. Halpern and R. Sochacka (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). p.223-31 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Studies were made on the bond rupture in Te^{131}-labelled dibenzyl telluride as a result of beta decay. The percentage yields of I^{131} activity in benzyl iodide, methyl iodide, phenyl iodide, iodotoluene, and inorganic forms were determined. It was confirmed that in 98% of events the Te–C bond was ruptured. The influence of phase change and of added scavengers was also studied. On the basis of the experimental results the hypothesis is advanced that the I^{131} atoms activated in beta decay do not undergo hot reactions. (auth)

11761 CHEMICAL STATE OF ARSENIC FORMED BY NUCLEAR TRANSFORMATION IN THE OXIDES OF GERMANIUM AND SELENIUM. G. B. Baró and A. H. W. Aten, Jr. (Institut voor Kernphysisch Onderzoek Amsterdam). p.233-9 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Studies were made on the chemical state of radionuclides formed in oxides and the change of this state during annealing processes. The distribution of As^{77} formed by beta decay of Ge^{77} in GeO_2 and of As^{76} formed by an (n,p) process in SeO_2 between the arsenite and arsenate fractions was determined. Annealing proved to be quite slow, even at temperatures appreciably higher than are necessary to increase the retention in most neutron irradiated solid salts. (auth)

11762 A METHOD FOR RANGE-DETERMINATION OF LOW-ENERGY IONS. Č. Jech (Inst. of Physical Chemistry, Czechoslovak Academy of Sciences, Prague). p.243-6 of "Chemical Effects of Nuclear Transformation. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

An attempt was made to measure the range of inert gas ions (krypton and radon) in solids, using beams of radioactive ions. A Penning-type ion source was fed with the labelled inert gas, and the beam of accelerated ions (2–6 kev) was allowed to impact on a metal target covered with a very thin layer of the substance in which the range was to be measured. From the number of ions (determined by activity measurements) captured in the layer or in the underlying target material it was possible to estimate the depth to which the ions had penetrated. Results obtained in this way for Formvar and nickel as absorbing materials are given. (auth)

11763 STOPPING OF BETA-DISINTEGRATION RECOILS. I. Tamir and N. H. Steiger (Israel Inst. of Tech., Haifa). p.247-54 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

A new method for the collection of beta-recoil atoms and the measurement of their penetrating power was developed. An ionized soluble monolayer, formed at the surface of an aqueous solution of an ionic surface active substance, serves as a source of beta-disintegrating atoms. The primary adsorbed surface active ions give rise to an electric

double layer within the liquid phase. In this way secondary adsorption of counter ions of opposite charge occurs at the surface. When the solution contains beta-active ions of opposite charge to those of the surface active species, some will join the electric double layer near the surface. It was found that beta-recoils originating from this layer are able to leave the surface (even if their kinetic energy is only of the order of magnitude of 1 ev) and can then be collected under atmospheric pressure. If the recoil atoms are themselves radioactive, they may be counted in a conventional way. The usual beta-recoil source is a monoatomic film adsorbed on a cleavage plane. In this case the adsorption energy is of the order of 1 ev so that an appreciable part of the recoil energy is lost on escape. The energy of escape from the electric double layer is small in comparison with the energies of a large part of the beta-recoil spectrum; most of the recoil atoms can therefore leave their place of formation losing only a small fraction of their energy. In order to reach the gas phase the beta-recoils have to penetrate the primary organic adsorption layer. When the expanded primary adsorption layer is gradually compressed, thus raising its mass per unit surface, the beta-recoil activity decreases continuously. This may be explained by the complete stoppage of the lower energy portion of the recoil-spectrum. Experiments have been performed on Bi^{212} recoil atoms resulting from the beta-disintegration of co-adsorbed $^{212}Pb^{2+}$ ions and possessing maximum recoil energies of 2.3 and 1.2 ev. The experimental arrangement used was a modification of an apparatus used for similar studies on alpha-recoils. (auth)

11764 THE CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS IN SYSTEMS OF GEOCHEMICAL INTEREST. F. S. Rowland, L. Hathaway, and T. Kambara (Univ. of Kansas, Lawrence). p.255-64 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Natural geochemical systems are re-examined for evidence of unusual chemical behavior resulting from nuclear reactions. It is believed that hypothetically, at least, such effects might explain some previously observed anomalies and perhaps provide additional information about the nature and the timing of the geochemical processes. Two separate systems which seem especially favorable for the observation of hot-atom effects are considered: the reactions of cosmic-ray produced nuclides in the atmosphere, and the chemical state of the decay products of the uranium and thorium radioactivity series in natural minerals. It is concluded that the experiments do not conclusively demonstrate that hot-atom reactions are actually creating observable effects in geochemical surroundings, but they show that the product nuclides are found in more than one chemical state in each system and suggest that energetic chemical reactions may well be playing a role in the results. (P.C.H.)

11765 THE HOT SYNTHESIS OF COMPOUNDS LABELLED WITH TRITIUM AND C^{14}. A. N. Nesmeyanov (Academy of Sciences, Moscow). p.269-90 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In Russian)

Quantitative studies were made on the effect of the mechanism of recoil atom reactions on the yield of labelled products. Ways of introducing a hot atom into the parent molecule such as the so-called hot and epithermal reactions and reactions taking place in the thermal region are discussed. In a study of tritium-labeled organic compounds obtained from the $Li^6(n,\alpha)T$ reaction, the yield of the parent substance was found to depend on the radiolysis of the parent molecule and the dimensions of the grains of lithium salt and not essentially on the intensity of the neutron flux. The chemical nature of the lithium salt did not influence the distribution or yield of the reaction products of the recoil tritium atoms. The distribution of tritium among the products of the reaction between the tritium recoil atom and cyclic hydrocarbons showed that the hot synthesis allowed a high yield of other labeled compounds besides labeled parent compounds to be obtained. Organic compounds labeled with C^{14} are produced by incorporating in the molecule a C^{14} recoil atom obtained from the $N^{14}(n,p)C^{14}$ reaction. To obtain substances of sufficiently high activity, nitrogenous organic compounds were irradiated in a nuclear reactor for 10 days or longer, which resulted in strong radiation decomposition and the production of a large quantity of polymeric substances. The substitution of C^{14} for nitrogen and carbon in the case of aromatic derivatives must proceed by the mechanism of hot reaction, and the distribution of substitution products is close to statistical, whereas in labeled compounds of the aliphatic series the activation distribution is not governed by statistical laws. The general behavior patterns due to the effects of temperature, phase, initial recoil energy, and of additions of different inert and inhibiting substances are discussed. (auth)

11766 PREPARATION OF SHORT-LIVED FISSION-PRODUCT ISOTOPES BY FISSION RECOIL. T. Nakai, S. Yajima, S. Ichiba, Y. Kamemoto, K. Shiba, and M. Handa (Japan Atomic Energy Research Inst., Tokyo). p.301-10 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Pellets were prepared by uniformly mixing fine uranium dioxide powder of a particle size of approximately 0.2 μ with natural graphite powder of a particle size of 30–70 μ in the ratio by weight of 1:30. After irradiation in the reactor, these pellets were heated in a stream of helium at about 1000°C and volatile fission products, such as Kr^{85m}, Xe^{133}, Xe^{135}, I^{131}, I^{133}, and Te^{132} diffused from the pellets, were each captured in a suitable trap. The experiments showed that these short-lived fission-product isotopes can be prepared continuously and with a good yield by irradiating the pellets described above in the in-pile loop under heating at about 1000°C in a helium stream. Basic factors were investigated, such as the relationship between the yield of I^{131} and the ratio by weight of oxalic acid to uranium dioxide in the pellet, the chemical form of I^{131} in solution, and various other factors. For the preparation of a series of short-lived fission product isotopes, a modified process was developed where graphite powder is used as medium. The diffusion at a high temperature of volatile fission-products, such as krypton, xenon, iodine, and tellurium, in various kinds of graphite was investigated and the activation energies of these nuclides were determined. The results indicate that the diffusion of these fission products in a graphite grain follows a very complicated mechanism and that the range of diffusion in natural graphite is appreciably greater than in artificial graphite or amorphous carbon. (auth)

11767 ENRICHMENT OF HOT ATOMS BY NEUTRON-IRRADIATION OF ANION-LOADED ION EXCHANGER. N. Saito, I. Tomita, M. Furukawa, and R. Shiomi (Tokyo Univ.). p.313-18 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

A new method is proposed for enriching recoil atoms arising from the (n,γ) reaction on ion exchangers loaded

with anions such as arsenate. A strong-base anion exchanger, Dowex 1, was loaded with arsenate, air-dried, and subjected to thermal neutron irradiation. After the bombardment, the samples were immersed in water and the resulting slurries were placed in a glass tube to make up resin beds. The separation of As^{76} from the target was carried out by successive elutions of the resin with water, 8 N HCl and 1 N HCl. Elution with water was so effective that some 40–50% of the total As^{76} activity in the resin came out in the effluent. More than 99% of the As^{76} atoms in this effluent had +3 oxidation state. An enrichment factor of more than 10^3 was obtained for this fraction. It is interesting that some fraction of radioactive arsenic was trapped in the resin matrix so firmly that it could hardly be removed by elution. The radiation decomposition of the resin was found negligibly small in these experiments. (auth)

11768 RECOIL-LABELLING IN MIXTURES OF SOLIDS BY RESONANCE NEUTRONS AND NUCLEAR FISSION. F. Baumgaertner and P. Reichold (Technische Hochschule, Munich). p.319-24 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

A description is given of an aimed recoil synthesis of labeled metal organic compounds in mixtures of solids, using recoil atoms from resonance neutron-capture and nuclear fission. (auth)

11769 EFFECTS OF PILE IRRADIATION ON THE CATALYTIC ACTIVITY OF MANGANESE DIOXIDE. J. Shankar, S. B. Srivastava, and M. H. Rao (Atomic Energy Establishment, Trombay, India). p.327-35 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Irradiation of MnO_2 with pile neutrons in the core of APSARA (a swimming-pool-type reactor) was observed to enhance the catalytic activity under certain conditions. It was further noticed that, with progressively high integrated neutron flux values, the activity decreases. Thus, for nvt = 1.6×10^{17} n/cm^2, 2.03×10^{17} n/cm^2, and 4.2×10^{17} n/cm^2 the reaction rate constant, k, has values of 38.3×10^{-5}/sec, 30.2×10^{-5}/sec, and 27.83×10^{-5}/sec respectively, as compared with 27.0×10^{-5}/sec for the unirradiated catalyst. The value of the activation energy corresponding to nvt = 1.6×10^{17} n/cm^2 is found to be 3.1 kcal/mole. By comparison with the effect of neutron irradiation, exposure of a sample of MnO_2 to an integrated gamma-ray flux of 4.3×10^7 r decreased the value of k from 27.0×10^{-5}/sec to 24.9×10^{-5}/sec. Post neutron irradiation heating of the sample was found to decrease the catalytic activity of MnO_2. On annealing for 48 hours at 140°C the value of k decreased from 38.3×10^{-5} sec^{-1} to 26.8×10^{-5} sec^{-1}. On the other hand, under similar treatment samples irradiated with higher neutron fluxes showed an initial sharp increase followed by a gradual decrease in the value of k. This phenomenon is explained in terms of radiation damage and its subsequent annealing. (auth)

11770 CHEMICAL EFFECTS OF RECOILING FISSION FRAGMENTS IN POTASSIUM NITRATE AND IODATE. U. Bertocci, R. B. Jacobi, and G. N. Walton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.337-45 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In English)

Results are reported for the decomposition caused by gamma rays from Co^{60}, and fission fragments from an irradiated uranium film, on solid potassium iodate. By the use of absorbers the decomposition caused by fission fragments is also measured over different ranges of the fission tracks. The decomposition for unit energy decomposition is greater for fission fragments than it is for gamma rays. This difference was also observed in the decomposition of potassium nitrate, and the effect is attributed to the density of energy deposition by fast-moving heavy particles. Potassium iodate is proposed as a good indicator for heavy-particle damage. (auth)

11771 A STUDY OF RADIATION DAMAGE BY FISSION PRODUCTS IN MICROPOROUS MATRICES. R. Coekelbergs (Société Belge de l'Azote et des Produits Chimiques, Marly), P. A. Gosselain, L. J. Schotsmans, and A. Crucq. p.347-62 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In French)

A study was made of the structural modifications of microporous nuclear fuels caused by gamma- and neutron-fission products in the BR-1 reactor at Mol. The porosity was determined by the density method with helium and mercury; the pore spectrum was determined by analysis of the nitrogen desorption isotherms at the temperature of liquid nitrogen, and also by high-pressure mercury porosimetry; the surface/weight ratio was determined by a classical method. In all cases a marked decrease was noted in the porosity and the surface/weight ratio. For radiation doses of the order of 5×10^{23} ev/g, this decrease is always more than 50% of the initial value for ESAU and CAU fuels, near this value for C8U fuels, and under 25% for the ECU fuels which are more stable. A tentative explanation of the damage is based on local heating caused by passage of the fission products, correlated with the effect of the recoil nuclei on the material. (auth)

11772 CROSS-LINKING OF PTFE (TEFLON) AND OTHER POLYMER MATERIALS BY THE LOCALIZED ACTION OF NEUTRON IRRADIATION. V. I. Gol'danskii, I. M. Barkalov, B. G. Dzantiev, and E. V. Egorov (Inst. of Chemical Physics, Academy of Sciences, Moscow). p.363-9 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In Russian)

Localization of radiation near the cross-linked surfaces was achieved by the surface absorption of boron- or lithium-containing compounds resulting from $B^{10}(n,\alpha)Li^7$ or $Li^6(n,t)He^4$ reactions. At thermal-column conditions the localization coefficients may be higher by several orders. Experiments were carried out under common reactor conditions at L ≈ 160 (normal B_2O_3 in surface layer; $C_B^{10} = 0.063$). The following pairs of polymer materials were cross-linked: PTFE–polystyrene, PTFE–PMMA, polyethylene–polystyrene, polyethylene–PMMA, polystyrene–PMMA. The strength of the junction of the above-mentioned cross-linked materials was of the order 100–200 kg/cm^2. The dependence of this strength (for the PTFE–polystyrene couple) on the dose in surface layer is given. The possible mechanisms of cross-linking in the surface layer are discussed. One of the most probable explanations refers to localized super-heating of microzones along the He^4 and Li^7 tracks. Three-layer systems consisting of material I—intermediate boron-containing polystyrene film—material II were also investigated. By neutron irradiation of such systems a junction of the following materials (≈100 kg/cm^2 strength) was obtained: PTFE–PTFE, PTFE–polyethylene, PTFE–aluminum, polyethylene–aluminum, PMMA–aluminum, PTFE–quartz. (auth)

11773 THE EFFECT OF Co^{60} ON THE DECOMPOSITION RATE OF COBALT FORMATE. B. V. Erofeev and V. A. Protashchik (Inst. of Physics and Organic Chemistry, Academy of Sciences, Minsk). p.371-6 of "Chemical Ef-

fects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961. (In Russian)

Addition of Co^{60} to cobalt formate considerably reduces the specific rate of decomposition. This effect increases the longer the samples are kept. The effect of Co^{60} on the maximum rate of decomposition is far less marked. An analysis of the rate of decomposition using the topokinetic equation $\alpha = 1 - e^{-kt^n}$ shows that the index n in the equation decreases with increasing content of Co^{60} in the sample, this being explained in terms of the influence of the nuclear transformations of Co^{60} on the first stages of formation of the metallic nuclei, which catalyze further decomposition of the formate. (auth)

Raw Materials and Feed Materials

11774 (NLCO-685) SUMMARY TECHNICAL REPORT [ON FEED MATERIALS] FOR THE PERIOD APRIL 1, 1957 TO JUNE 30, 1957. John W. Simmons, ed. (National Lead Co. of Ohio, Cincinnati). Contract AT(30-1)-1156. 165p.

A refinery test using Porter Brothers concentrate as feed demonstrated the feasibility of phosphate complexing of thorium on a plant scale. Orange oxide containing less than 50 ppm thorium (uranium basis) was produced in the plant refinery by the phosphate complexing of Algom, Bicroft, and Faraday thorium-bearing concentrates (0.2 to 1% thorium on a uranium basis). Plant-scale tests successfully demonstrated the application of the drum dryer-rotary calciner technique for the recovery of nitrate values from solvent-extraction raffinates. A laboratory-scale flow cell was fabricated to permit the continuous electrolytic removal of chlorides from nitric acid solutions. The results of laboratory tests indicated that the total heat input and the finishing temperature used in denitration affect the volatiles content of the product orange oxide. The volatiles content, in turn, is correlated to the real density, the surface area, and the reduction time of the product orange oxide. It was found that sodium and potassium in UO_2 can adversely affect the rate of conversion of UO_2 to UF_4 and that sodium in UO_2 can contribute to agglomeration under conditions used in the hydrofluorination reactor. Plant tests demonstrated the advantage of sulfating Port Hope UO_3. Nitrogen dilution of the dissociated ammonia feed gas to the reduction reactor of the moving bed reactor gave improved temperature control. Up to 90% UF_4 product was obtained by two-pass hydrofluorination of brown oxide (UO_2). The direct conversion of uranyl ammonium phosphate to a cascade-quality UF_4 by means of gas phase reduction and hydrofluorination was found to be chemically feasible by laboratory tests. Processing difficulties would be expected if this process were used in existing UF_4 production facilities, however. An oxidation technique was developed for recovery of uranium from uranium-niobium alloy scrap, giving approximately 98% uranium recovery and avoiding the explosion hazard associated with nitric acid dissolution of the metallic scrap. Accuracy and linearity of better than 0.25% were achieved in a recording thermogravimetric balance developed for laboratory study of gas-solid reactions. Magnesia was studied as a possible reaction vessel liner for the process in which uranium tetrafluoride is continuously reduced to metal. Magnesia was not attacked by molten magnesium fluoride during a time period of six hours. The effects of remelt charge constituents on the chemistry of uranium ingots and the percentage yield of good slugs were evaluated. Chemical composition of the ingots varied for the different types of all-derby and all-scrap charges. The all-scrap charges gave lower percentage yields of good slugs than did the all-derby charges. Uranium washers were produced by impact-forging washer blanks and then machining. This method of washer fabrication offers a substantial increase in metal savings and the elimination of several processing steps, as compared to the present method of producing washers. In preliminary internal broaching tests, uranium was broached at speeds up to 327 inches per minute. Experimental results during this quarter indicated that uranium metal beta-heat-treated in molten NuSal (50% NaCl–50% KCl) picks up less hydrogen than does uranium metal heat-treated in a 25% Li_2CO_3–75% K_2CO_3 eutectic salt mixture. Laboratory and pilot plant studies demonstrated the feasibility of producing acceptable vacuum-remelt metal from uranium metallic scrap by a process of melting in atmosphere under a protective salt. The preparation of metal-grade UF_4 from UO_4 via a two-step batch reactor process was shown to be practical. Temperature control was critical, both in the primary hydrogen reduction step and in the subsequent hydrofluorination step. The per cent of iron volatilized from a U_3O_8 matrix during spectrographic excitation was determined by the use of radioactive Fe^{59} under two different sets of excitation conditions. A polarographic method for measuring uranium(VI) is recommended as a referee method for the determination of UO_2F_2 in UF_4. The flame photometric method was successfully adapted for the determination of sodium, lithium, and potassium in concentrated solutions of uranyl nitrate. (auth)

11775 (NLCO-790) SUMMARY TECHNICAL REPORT [ON FEED MATERIALS] FOR THE PERIOD APRIL 1, 1959 TO JUNE 30, 1959. John W. Simmons, ed. (National Lead Co. of Ohio, Cincinnati). July 20, 1959. Contract AT(30-1)-1156. 83p.

Anaconda Acid, Kermac, Moab, Rifle, and Texas Zinc uranium concentrates were evaluated (the laboratory portion of feed material evaluation). Laboratory equilibrium tests and Pilot Plant 2-inch-column extraction tests demonstrated effective distribution of uranium into a TBP-kerosene solvent from aqueous phases containing as little as 0.5N HNO_3 and varying amounts of added metal nitrates ($NaNO_3$). The concentration of associated nitric acid in dilute aqueous nitric acid solutions was determined after values were obtained for the equilibrium constant for the reaction of tri-n-butyl phosphate with associated nitric acid and for the equilibrium distribution constant for the partition of associated nitric acid into tri-n-butyl phosphate. Optimum partition of uranium into tri-n-butyl phosphate was realized in the laboratory by using an aqueous uranyl nitrate solution containing sufficient hydrogen ions to promote extraction and a low concentration of associated nitric acid. An Ohmart system for controlling the uranium profile in the "A" extraction column was installed on Refinery pulse columns. Use of this system improved control but did not stop all column upsets. The effect of 13 to 189 ppm sodium contamination upon hydrofluorination conversion of UO_2 to UF_4 can be decreased or eliminated by reducing the temperature at the site of the reaction. Uranyl sulfate was shown to undergo an enantiotropic transition at 755°C and to decompose to U_3O_8 in an atmosphere of oxygen sulfur dioxide, which gases are evolved during decomposition. Decontamination of sodium, calcium, nickel, magnesium, gadolinium, and dysprosium was achieved in a laboratory investigation of the ADU process. UO_2 produced by reductions programmed from 700 to 1100°F was hydrofluorinated at programmed temperatures of 550 to 1100°F and isothermally at 1100°F. Good conversion was obtained for material whose source was ADU calcined at 1200°F. Uranium derbies were classified by the present method of derby grading and were then examined for slag coverage, slag volume, and

slag weight. There was a high degree of overlap of these parameters for adjacent grades. A hydraulic separator for separating uranium from magnesium and magnesium fluoride was fabricated. Excellent separation was obtained for +16 mesh material. A hydrochloric acid dissolution-UF_4 precipitation process for routing scrap materials to the reduction-to-metal step was examined. The purification obtained was noted, and process conditions were varied to determine their effect upon UF_4 density, UF_4 purity and precipitation time. Three types of uranium scrap were subjected to the HCl dissolution-aqueous precipitation Winlo process to determine the purification achieved. Green salt made from dolomitic bomb liner residues was found to be grossly contaminated. Acceptable green salt was made from pickle liquor treated with formaldehyde and from pickle liquor plus black oxide. Nominal 80% yields were obtained in the recovery of magnesium metal by reaction of calcium carbide with magnesium fluoride slag and in the recovery of HF by the reaction of sulfuric acid with magnesium fluoride slag. A sample holder for use in quantitative preferred orientation studies was fabricated. The holder, designed to fit a North American Philips Goniometer, will accommodate specimens up to $1^{13}/_{16}$ inches in diameter and incorporates a precision ball bearing. A satisfactory technique was developed for the analysis of uranium metal for traces of fluoride. A direct flame photometric method is given for the determination of magnesium in uranium ore concentrates. No chemical separation step is required, except for high-iron-content ores. (auth)

11776 OBTENTION OF URANIUM HEXAFLUORIDE FROM THE TETRAFLUORIDE UTILIZING FLUORINE AS FLUORINATION AGENT. J. M. Guillen Galban and N. Darnaude Rojas-Marcos (Junta de Energia Nuclear, Madrid). Energia nuclear (Madrid), 5: 4-11 (July-Sept. 1961). (In Spanish)

The obtention of fluorine in an electrolytic cell and the separation of the hydrofluoric acid which contains, as a result of the distillation of the electrolyte, a mixture of KF·HF and HF are described. The fluorination of uranium tetrafluoride, which takes place in a cylindrical Monel oven at 500°C, is described. The recovery of the gaseous UF_6 in a cold trap at −78°C and its transfer and storage are also considered briefly. (tr-auth)

11777 PROCESS FOR RECOVERY OF URANIUM AND VANADIUM FROM CARBONATE SOLUTIONS BY REDUCTION PRECIPITATION. David Allen Ellis and Robert Olaf Lindblom (to U. S. Atomic Energy Commission). British Patent 891,457. Mar. 14, 1962.

An economical process for the precipitation of U and V from carbonate leach solutions prepared from ores is given which permits the leach solutions to be recycled. The process may be used with solutions containing either large amounts of salt or no salt and comprises treating the solutions with a sodium amalgam containing 0.05 to 0.3% sodium, whereby U and V are precipitated as reduced forms. The U and V in turn may be separated from each other by anion exchange. The process is adaptable to continuous operation. (D.L.C.)

11778 ANIONIC EXCHANGE PROCESS FOR THE RECOVERY OF URANIUM AND VANADIUM FROM CARBONATE SOLUTIONS. Richard Hazel Bailes, David Allen Ellis, and Ray Smith Long (to U. S. Atomic Energy Commission). British Patent 891,521. Mar. 14, 1962.

An ion exchange process is outlined for recovering U and V from low-chloride solutions obtained by leaching various ores with an alkali metal carbonate. In the process, the solution is contacted with a column of a strongly basic anionic exchange resin, preferably −50 + 100 mesh Dowex 1, and U and V are selectively eluted from the resin and then recovered from the eluates by precipitation. The selective elution may be carried out in three ways: (1) selective elution of U with $(NH_4)_2SO_4$ solutions followed by elution of V. (2) selective elution of V with NaCl and SO_2 solutions followed by elution of U. (3) selective elution of U by leach solution and re-adsorption on a second column, followed by elution of V and U from the first and second columns, respectively. A flowsheet and comparative graphs for elution by various solutions are given. (D.L.C.)

Separation Processes

Refer also to abstracts 11959 and 12649

11779 (EURAEC-134) REPROCESSING OF IRRADIATED FUELS. Quarterly Report No. 1 (2nd Year), April–June 1961. (Brussels. Centre d'Etude de l'Energie Nucléaire). July 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract [008-60-4RDB]. 29p. (R-2020)

The investigation of certain chlorination reactions of uranium oxide was continued. Practical quantitative results were obtained when transforming UC to UF_4 and cermets (UC and UO_2) to UO_3. The time required for oxidizing sintered UO_2 to U_3O_8 was appreciably reduced and the yields of UF_4 rose from 80 to 95%. The transformation of UF_4 to UF_6 is being studied. The equipment of the Plutonium Laboratory is almost complete. The preliminary research stage on the operational characteristics of the distillation unit was terminated. (auth)

11780 (EURAEC-165) DECONTAMINATION FACTOR OBTAINED DURING RETREATMENT BY VOLATILIZATION OF IRRADIATED URANIUM OXIDE. Special Report No. 2. J. Schmets and R. Heremans (Brussels. Centre d'Etudes de l'Energie Nucléaire). Sept. 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract [008-60-4RDB]. 49p. (BLG-58)

A study was made of the elimination of fission products during a retreatment cycle of UO_2, comprising the following stages: oxidation, reduction, hydrofluorination, and fluorination. The elimination of fission products by means of sodium fluorides was also investigated. The decontamination factors produced generally reduced the uranium activity to a level comparable with that of non-irradiated uranium. The activity of the end product was caused mainly by the presence of fairly short-lived isotopes. Purity standards for irradiated uranium, the decontamination factor and its variation with time, and decontamination in individual fission products and the part played by sodium fluoride are discussed. Conclusions were drawn with a view to making use of the results obtained in a pilot plant. (M.C.G.)

11781 (HW-69415) CONTINUOUS DISSOLUTION OF PLUTONIUM-BEARING SLAG AND CRUCIBLE RESIDUES. H. W. Crocker (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1961. Contract AT(45-1)-1350. 15p.

Laboratory runs demonstrated successful dissolution of plutonium-bearing slag and crucible residues. The plutonium recovery was quantitative. Vigorous reaction during initial dissolution of each solids charge caused formation of large quantities of reaction foam. While the foam subsides in a few minutes, the foam volume could result in a boilover from the dissolver. Charging of smaller batches more

frequently will minimize the problem. All the experimental runs exhibited the formation of a residual solids heel in the dissolver. Since heel dissolution is slow, periodic dissolver clean-out runs will be required to maintain a low heel volume. Any excessive solids heel buildup can be removed and dissolved in a lengthy batch treatment using 4M HNO_3 or 6M HCl. The residue in a 32-hour continuous run was 8% by weight of the solids charged. It was determined that a 27.5 g/l iodate concentration was required in the dissolver overflow solution to precipitate plutonium iodate. The iodate concentration in the continuous dissolver is much less than this value (<5 g/l); therefore, formation of this inextractable precipitate should not be encountered. Dissolver overflow solution adjusted to solvent extraction feed composition was contacted with 20% TBP–80% CCl_4 (volume basis). Four stages of extraction reduced the plutonium concentration in the aqueous feed to 0.003 g/l. Storage of feed material for five days did not effect the plutonium extraction. The presence of up to 0.08M titanium or 0.3M sulfate did not decrease the extractability of the plutonium. (auth)

11782 (HW-70792) PLUTONIUM RECOVERY FROM CONTAMINATED MATERIALS, PROJECT CGC-813, 232-Z BUILDING, 200-W AREA. FINISHED PRODUCTS CHEMICAL TECHNOLOGY NEUTRON MONITORING INVESTIGATION. C. G. Wills (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 23, 1961. 27p.

A discussion is given of the investigation of the neutron monitoring characteristics for the determination of the extent of plutonium accumulation in incinerators. The study was made to establish a basis for relating the count rate observed during operation to the amount of plutonium present. (B.O.G.)

11783 (IDO-14572) A BENCH-SCALE NATURAL-RECIRCULATION DISSOLVER. E. E. Erickson (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Jan. 10, 1962. Contract AT(10-1)-205. 23p.

A natural-recirculation dissolver closely approaching a stirred-tank reactor in behavior was developed, and its feasibility was demonstrated in the mercury-catalyzed dissolution of aluminum in nitric acid. It was designed to utilize the heat of reaction and evolution of gaseous reaction products for recirculation and mixing. The dissolvent was 5-molar nitric acid, containing mercury in concentrations from 10^{-4} to 10^{-3} molar as a catalyst. Dissolution rates for 1/7 scale, simulated MTR fuel elements of 2-S aluminum ranged from 0.25 to 4.0 mg/(cm^2)(min), depending on the catalyst concentration in the dissolvent and the dissolvent flow rate. For comparable catalyst and acid feed concentrations, dissolution rates, based on unit net superficial velocities, were nearly 25 times those for dissolution of randomly-packed flat plates in a pilot plant, continuous, flooded dissolver. (auth)

11784 (IDO-14578) SALT PHASE CHLORINATION OF REACTOR FUELS. III. CATALYZED DISSOLUTION OF URANIUM DIOXIDE IN LEAD CHLORIDE–CHLORIDE SYSTEMS. E. M. Vander Wall, D. L. Bauer, and H. T. Hahn (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 5, 1962. Contract AT(10-1)-205. 19p.

The rapid dissolution of uranium dioxide is described, wherein copper is added to molten lead chloride at 550°C, and chlorine is passed through the melt. The integral dissolution of zirconium-clad uranium dioxide fuels is also described. The dissolution rate of uranium dioxide is directly proportional to the concentration of cuprous chloride if an excess of chlorine is used; the value for the rate constant is approximately 100 mg (UO_3) cm^{-2} min^{-1}/(CuCl molality). The uranium dioxide is converted to water soluble uranyl chloride. The dissolution rate can be controlled by three factors: the copper concentration, the flow rate of chlorine, and the surface area of uranium dioxide. Scoping work indicates that iron chloride may be as effective catalytically as copper chloride for uranium dioxide dissolution in the lead chloride–chlorine system at 550°C; thallium chloride is not as effective. (auth)

11785 (NYO-9175) THE DECONTAMINATION AND RECOVERY OF PRECIOUS METALS. Final Report, April 1, 1960 through May 1, 1961. L. P. Pepkowitz, B. L. Vondra, W. C. Judd, J. E. Scott, G. G. Ehrlich, and E. R. Shuster (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT(30-1)-2528. 123p.

Investigations concerned with the decontamination and recovery of precious metals, resulted in considerable basic and applied information for the recovery of chemically and radiochemically pure Pt, Rh, Ir, Pd, and Au. An economical production scale process was attained by the development of a continuous solvent extraction process which results in a product meeting the chemical and radiochemical specifications. A conceptual solvent extraction flow sheet was designed based on these experimental results. In addition to the chemical process development, the nature of the radioactivities present, the specifications for acceptable material and methods of identification and measurement were also investigated and delineated. Considerable effort was devoted to the chemical analytical problems involved and methods were devised or adapted for scrap identification, process control, purity of the final products and accountability control. Especial emphasis was given to x ray fluorescence procedures because of their sensitivity, specificity, rapidity, and convenience of measurement. (auth)

11786 (ORNL-3219) AQUEOUS PROCESSING OF THORIUM FUELS. R. E. Blanco, L. M. Ferris, and D. E. Ferguson (Oak Ridge National Lab., Tenn.). Mar. 14, 1962. Contract W-7405-Eng-26. 35p.

The status of aqueous processing methods for thorium fuels is summarized, with principal emphasis on the stainless steel-clad ThO_2–UO_2 type. Data were obtained principally from laboratory-scale experiments with fully irradiated fuel samples and engineering-scale tests with unirradiated fuel. Stainless steel cladding was easily dissolved with 4 to 6M H_2SO_4 (Sulfex process) or 5M HNO_3–2M HCl (Darex process) in LCNA (Nionel type) or titanium equipment, respectively, in semicontinuous or batch equipment. Uranium losses to the decladding solutions were ~0.3% and 3 to 5% for the Sulfex and Darex processes, respectively, with fuel irradiated to ~20,000 Mwd/ton of core. The uranium was readily recovered from the Darex decladding solution in the acid Thorex extraction process. The ThO_2–UO_2 core was dissolved in 13M HNO_3–0.04M NaF–0.1M $Al(NO_3)_3$. Uranium and thorium can be recovered from graphite-base fuels by disintegration and leaching with 90% HNO_3, grinding and leaching with 70% HNO_3, or combustion followed by dissolution in fluoride-catlyzed nitric acid. Uranium and thorium were recovered from nitric acid solutions and separated from fission products by extraction with 30% tributyl phosphate in Amsco in the acid Thorex process. The use of an acid deficient feed (0.15M a.d.) induced high decontamination while injection of nitric acid at the fourth extraction stage provided high salting strength and ensured quantitative uranium and thorium extraction. Extensive studies with other organophosphorous extractants established the relations between metal extraction, radiation stability, and metal complex solubility with P-C or P-O bonding and chain branching.

Di-sec-butyl phenylphosphonate (DSBPP) combined many of the advantages found and is applicable to the separation of uranium from thorium fission products. Since the thorium distribution coefficients (or Th/F.P. separation factors) were low, none of these extractants is potentially useful for recovery and decontamination of both thorium and uranium. (auth)

11787 (ORNL-3244) SEPARATION OF TRANSPLUTONIUMS AND LANTHANIDES BY TERTIARY AMINE EXTRACTION. II. CONTAMINATIONS. R. D. Baybarz and H. B. Kinser (Oak Ridge National Lab., Tenn.). Mar. 7, 1962. Contract W-7405-Eng-26. 13p.

The results of laboratory experiments showed that in extraction of transplutonium elements from 10.85 M LiCl by 30% Alamine-336 in diethyl benzene, Cr^{3+}, Ce^{3+}, Eu^{3+}, Y^{3+}, Ba^{2+}, and Sr^{2+} in the feed will remain in the aqueous phase. Cd^{2+}, Hg^{2+}, Pd^{2+}, Fe^{3+}, Co^{2+}, Mn^{2+}, Sn^{4+}, Tl^{4+}, Cu^{2+}, TcO_4^-, Zn^{2+}, Zr^{4+}, Ru^{3+}, MoO_4^{2-}, Ni^{2+}, and Pb^{2+} will be extracted, but in the stripping of the transplutoniums from the organic with 5 M HCl, all of these ions except Ni^{2+} and Ti^{4+} will remain in the organic. The presence of Br^-, F^-, and ClO_4^-, and acetate in the extraction feed in concentrations up to 0.1 N does not drastically affect the separation factors of transplutoniums and lanthanides, but I^- and NO_3^- in 0.7 M concentrations decrease the separation factor to 1. (auth)

11788 (ORNL-TM-107) CHEMICAL TECHNOLOGY DIVISION, CHEMICAL DEVELOPMENT SECTION C PROGRESS REPORT FOR OCTOBER–DECEMBER 1961. K. B. Brown (Oak Ridge National Lab., Tenn.). Feb. 21, 1962. Contract [W-7405-Eng-26]. 48p.

Recovery of Th (and U) from Granitic Rock. Recovery of Th by acid leaching ten additional granite samples (36 to 82 ppm Th) from the Conway formation in N. H. ranged from about 50 to 85%, and averaged about 70%. Study of the effect of grind size on the recovery of Th from Conway and Pikes Peak granites showed no significant differences in the range minus 20 to minus 200 mesh. The Th concentration in a sized Conway granite sample was found to be much greater in the fine than in the coarse fractions, whereas Pikes Peak granite showed only slight Th enrichment in the finer fractions. U recoveries in acid leaching of four different granite samples were not improved by adding an oxidant. Collection and Analysis of Granite Samples. A field survey of the Conway granite formations in N. H. was made. Preliminary analysis of the data indicates that the accessible surface of the Conway granite averages at least 40 ppm Th. Collection and Analysis of Lateritic Soils. The Th concentration ranged 5 to 16 ppm in twenty-two samples of sub-lateritic soil from Miss., Ala., Ga., and Va. Final Cycle Pu Recovery by Amine Extraction. In continued batch countercurrent testing with simulated Purex 1BP solution of the proposed chemical flowsheet for final cycle Pu recovery by amine extraction, the extraction profile with the amine (TLA) concentration decreased from 0.3 to 0.15 M again confirmed the predicted extraction isotherm. The product solution contained 23 g Pu/liter (nominal x20 concentration factor), and the stripped organic and the raffinate contained, resp., 0.001 and <0.002 g/liter. Extraction and Separation of Zr and Hf. Results are summarized for tests on the extraction and separation of Zr and Hf with amines and organophosphorus esters and acids. All three extractant classes showed some promise but the studies were not sufficiently extensive to define complete processes. Separation of Rare Earths and Transplutoniums. Extraction of all lanthanides from concentrated LiCl and mixed LiCl–$AlCl_3$ solutions by various tertiary amines was greater than that of Y. Order of extractability and differences from Y varied with composition of both organic and aqueous solutions. Sc varied widely in extractability with solution composition, being similar to Eu under some conditions and to Am under others. Amine extractions of rare earths from thiocyanate solutions were very small. Extraction of HNO_3 and $Fe_2(SO_4)_3$ from Purex 1WW Solution. Approximately 90% of the nitrate and Fe and a major portion of the sulfate were extracted from synthetic Purex 1WW solution with a primary amine. This treatment produces a solution of low salt content which is highly amenable to solvent extraction recovery of Sr and possibly Cs. (auth)

11789 (ORNL-TM-130) HOT CELL DEMONSTRATION OF ZIRFLEX AND SULFEX PROCESSES. Report No. 2. J. H. Goode and M. G. Baillie (Oak Ridge National Lab., Tenn.). Jan. 26, 1962. Contract W-7405-eng-26. 21p.

Twelve Zircaloy-2 clad UO_2 specimens, irradiated in the NRX to about 15,500 Mwd/t and decayed about 9 months, were declad and core dissolutions completed. The pellets were fractured but were essentially intact (i.e. had not fallen apart) when declad. The U losses ranged from 0.03 to 0.09%, due to solubility of U(IV) in the Zirflex reagent, and the U losses from 0.01 to 0.04%. The core pellets were 99.5% dissolved in 4 M HNO_3-0.1M $Al(NO_3)_3$ in 5 hr, which was slightly faster than the rate of unirradiated pellets. (auth)

11790 (AEC-tr-5018) TERTIARY AMINE EXTRACTION AND PURIFICATION OF PLUTONIUM. M. de Trentinian and A. Chesne (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated by A. L. Monks (Oak Ridge National Lab., Tenn.) from Report CEA-1426. 1960. 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 2695.

11791 (AWRE/TRANS/27) CHROMATOGRAPHIC METHOD FOR THE COMPARATIVE EVALUATION OF THE STABILITY OF COMPLEX COMPOUNDS. First Report. M. M. Senyavin and L. I. Tikhonova. Translated by A. S. Dyer (U.K.A.E.A. Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) from Zhur. Neorg. Khim., 1: 2772-7(1956). 11p.

The stability of various complexes formed by complexing agents (viz., citric acid, EDTA, uramildiacetic acid, cyclopentanediaminetetraacetic acid, and cyclohexanediaminetetraacetic acid) with metal ions (e.g., Zr, Y, and Sr) is studied by ion-exchange chromatography. The ion-exchange resin used gives valid results over a wide range of pH values, including those of biological interest. (T.F.H.)

11792 STUDIES ON THE SOLVENT EXTRACTION OF URANYL BIS(DIBENZOYLMETHANE). George K. Schweitzer and Jack L. Mottern (Univ. of Tennessee, Knoxville). Anal. Chim. Acta, 26: 120-7(Feb. 1962). (In English)

Studies of unmasked and masked extractions of the uranyl bis(dibenzoylmethane) · dibenzoylmethane chelate from aqueous solutions into chloroform containing dibenzoylmethane were made. Aqueous media containing the following were studied: perchlorate, fluoride, acetate, oxalate, citrate, tartrate, nitrilotriacetate, and ethylenediaminetetraacetate. A number of fundamental constants were determined, these values allowing theoretical interpretations of several of the systems to be made. (auth)

11793 RECOVERY OF URANIUM FROM SPANISH MINERALS WITH AMINES OF NATURAL LEACH SOLUTIONS. Leandro Ramos Salvador and Jose Manuel Regife Vega (Junta de Energia Nuclear, Madrid). Energia nuclear (Madrid), 5: 48-55(July-Sept. 1961). (In Spanish)

A series of laboratory studies on the recovery of uranium by the natural leaching of an Albuquerque mineral (lot $^{7}/_{61}$) using liquid-liquid extraction with amines is reported. Two aqueous solutions of different concentration (1.20 and 2.02 g U_3O_8/l) were treated as part of the study on the effect of aqueous solution concentration on the cost of the final product, and two liquid amines, secondary LA-2 and tertiary DDBA, diluted to 5 per 100 v/v in kerosene were investigated. The reextraction of the uranium from the organic phase was made with various reagents such as NaCl, $NaNO_3$, and Na_2CO_3, this variable and the pH of the aqueous solution being the variables which exercise the most influence on the cost of the final product. Analyses which show the good quality of the sodium uranate obtained are reported. (tr-auth)

11794 STUDIES ON COUNTERCURRENT EXTRACTION OF RADIONUCLIDES. III. EXTRACTION BEHAVIOR OF NEPTUNIUM IONS IN HCl-TBP SYSTEM. Hassan M. Sammour (Cairo Univ.). J. At. Energy Soc. Japan, 4: 2-8 (Jan. 1962). (In English)

Using Np^{239}, the extraction behavior of neptunium ions was studied in the tri-n-butyl phosphate-hydrochloric acid system by the discontinuous countercurrent technique. The results indicate that 5.4N HCl is the most suitable acidity to effect a good simultaneous separation of the three stable oxidation species in solution. Neptunium(VI), the most extractable species, was only extracted in the organic phase, Np(V) being less extractable remained in the last 10 fractions of the aqueous phase and Np(IV) was concentrated in the first forty aqueous portions of the extractor. The separation permitted the calculation of the amount of each oxidation species in the original mixture. The effect of disproportionation of Np(V), reduction of the original mixture with zinc or oxidation with $KClO_3$, on the extraction behavior was examined and the results are explained. (auth)

11795 SOLVENT EXTRACTION OF METALS BY ORGANOPHOSPHORUS COMPOUNDS. I. GENERAL STUDY. Keichi Oshima (Japan Atomic Energy Research Inst., [Tokyo]). J. At. Energy Soc. Japan, 4: 8-16 (Jan. 1962). (In English)

A systematic study of the basic chemistry of solvent extraction of metals by organophosphorus compounds is reported. Thermodynamic and structural chemical approaches were employed. The thermodynamical treatment of the distribution equilibrium measurement was carried out rather precisely to analyze the mechanism of solvent extraction. This was applied to determine the compositions of the complexes formed and the chemical reactions underlying. Further, it was shown the competition of metal and proton acid could clearly explain the extraction behaviors in these systems. Spectroscopic measurements of the solvents were conducted. Especially, in the infra-red region, the shift of the P = 0 vibrational spectra of the solvent and the splitting of the NO_3 vibrational spectra of the nitrate ions gave very powerful measures to study the microscopic mechanism of complex formation between the solvent and the species extracted. The thermodynamic and structural chemical approaches turned out to be in good accord and complementary. (auth)

11796 PYROMETALLURGICAL PROCESSING OF NUCLEAR FUELS BY MOLTEN ZINC. Masayoshi Kanno and Sanya Kokubo (Tokyo Univ.). J. At. Energy Soc. Japan, 4: 30-6 (Jan. 1962). (In Japanese)

Fractional crystallization from low melting solvent metals using liquid zinc was investigated. The process involves the dissolution of an irradiated material in zinc with some flux and subsequent separation through crystallization and precipitation of intermetallic compounds (U_2Zn_{17}). The required reduction in solubility was accomplished by temperature change from 750 to 550°C. Specimens used were artificial fissium alloys containing zirconium made by vacuum resistant-heat melting and injection casting. The results of metallographic and chemical analyses of slow cooled zinc ingots containing 3% uranium, showed the availability of the separation between solvent zinc and precipitated U_2Zn_{17} phase of decantation. Thus separated cake which mainly consisted of U_2Zn_{17} containing from 6% to 16% uranium and the purified uranium sponges were recovered by vacuum distillation of these separated cakes at temperature 1000°C. The decontamination factors for zirconium obtained were 2.2 ~ 9.5 and it was calculated that they depend upon the uranium content in the separated cake theoretically and experimentally. (auth)

11797 OPERATING CHARACTERISTICS OF THE INCLINED PIPE TYPE EXTRACTOR ON URANIUM EXTRACTION. Taiji Kurihara, Hisao Kimura, Yutaka Yamamoto, Takehiko Ishihara, and Tetsuo Aochi (Japan Atomic Energy Research Inst., [Tokyo]). J. At. Energy Soc. Japan, 4: 37-44 (Jan. 1962). (In Japanese)

The flooding point, hold up of each phase, and extraction efficiency for the system water–uranylnitrate–30% TBP kerosene solution were studied in order to evaluate the use of the inclined pipe type extractor on uranium extraction. Spiral shaped, inclined pipe type extractors of acryl resin were used, the pipe diameters being 21.6 and 35.7 mm. The results show that the inclined pipe type extractor has special advantages which other extraction equipment heretofore has never had. That is, the flow capacity of this type of extractor is several times larger than that of a pulse column or another type extractor, and it is possible to adapt the height of this extractor in a comparatively wide range, by adjusting the pipe diameter and other factors. (auth)

11798 THE EXTRACTION OF THORIUM FROM NITRATE SOLUTION BY DIBUTYL BUTYL PHOSPHONATE. D. C. Madigan and R. W. Cattrall (Australian Mineral Development Labs., Parkside, S. Australia). J. Inorg. & Nuclear Chem., 21: 334-8 (Dec. 1961).

Thorium nitrate is more readily extracted by dibutyl butyl phosphonate (DBP) than by tri-n-butyl phosphate (TBP). It is extracted as a tri-solvate and the reaction may be represented by the equation $Th(NO_3)^{3+} + 3NO_3^- + 3DBP = Th(NO_3)_4 \cdot 3DBP$. The distribution of thorium to the organic phase is approximately halved when nitrobenzene is substituted for kerosene as a solvent for the reagent, but in either case the reaction is represented by the equation given. (auth)

11799 STUDIES ON MONO- AND DI-n-BUTYLPHOSPHORIC ACIDS. IV. THE EXTRACTION OF URANIUM(VI) FROM AQUEOUS NITRATE SOLUTION BY DI-n-BUTYLPHOSPHORIC ACID. C. J. Hardy (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 21: 348-58 (Dec. 1961). (AERE-R-3267)

The distribution of uranium(VI) between solutions of di-n-butylphosphoric acid (HDBP) in various organic diluents and solutions of nitric acid was studied as a function of the concentrations of HDBP, nitric acid, nitrate ion, and hydrogen ion, and of the nature of the diluent. The distribution coefficient (D_U, organic/aqueous) for uranium, which depends markedly on the nature of the diluent and increases in the order $CHCl_3$ < benzene < toluene < CCl_4 < kerosene, can be correlated with the dimerisation constant

for HDBP in the diluent. D_U shows a complex dependence on the aqueous nitric acid concentration (C_{HNO_3}), being proportional to $C^{-2}_{HNO_3}$ from 0.1–1 M HNO_3 and at > 8 M HNO_3, and to C_{HNO_3} from 3–6 M HNO_3. D_U is independent of the aqueous nitrate ion concentration in mixtures of nitric and perchloric acids at a constant ionic strength of one. The implications of these relationships on the mechanism of extraction and the types of complexes formed are discussed, and the extraction of uranium(VI) compared with the extraction of other metals from similar systems. (auth)

11800 STUDIES ON MONO- AND DI-n-BUTYLPHOSPHORIC ACIDS. V. THE EXTRACTION OF NITRIC ACID FROM AQUEOUS SOLUTION BY DI-n-BUTYLPHOSPHORIC ACID AND FURTHER RESULTS ON THE DISTRIBUTION OF DI-n-BUTYLPHOSPHORIC ACID IN AQUEOUS-ORGANIC SOLVENT SYSTEMS. B. F. Greenfield and C. J. Hardy (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 21: 359-65(Dec. 1961).

The distribution of P^{32}-labeled di-n-butylphosphoric acid (HDBP) between toluene and aqueous nitric acid was measured as a function of the concentration of HNO_3 from 0.5–12 M for 0.01, 0.05, and 0.5 M HDBP, and the concentration of HDBP from 10^{-5}–0.5 M for 1, 6, and 10 M HNO_3. The dimerization constant and monomer distribution coefficient for HDBP in toluene–1 M HNO_3 correspond to log $K_2 = 5.09$ and log $k_d = -0.70$. The amount of HNO_3 extracted by a 0.5 M solution of HDBP in toluene can be expressed by the relation $C_{HNO_3(org)} = 0.051\ C_{HNO_3(uncomined,aq)}$ up to 12 M HNO_3 in the aqueous phase; approximately 20% of the uncomplexed HDBP and 40% of the HDBP · HNO_3 complex are hydrated. A third phase forms in the 0.5 M HDBP–kerosene–HNO_3 system at < 4 M HNO_3 in the aqueous phase; at 12 M HNO_3 the third phase has the empirical formula HDBP · HNO_3 · H_2O. (auth)

11801 EXTRACTION OF BERYLLIUM OXIDE FROM BERYL BY CALCINING WITH GLAUBER SALT AND PURIFICATION BY ION-EXCHANGE. Wen-wu Yao, Ch'i-wen Chiang, and Hsueh-min Ku. K'o Hsüeh Chin Chan, No. 2, 24-6(1959).

Powdered beryl (containing 11.1% BeO), Na_2SO_4, and coal, were mixed in the ratio 2:3:3, placed in a crucible, and heated at 950° in an electric furnace in a reducing atmosphere. Sulfuric acid was added to the ground product and the mixture was milled to a gluey state, evaporated to emission of white fumes, cooled, drowned with water, and admixtures were filtered off. Hydrogen peroxide was used to oxidize Fe^{2+} to Fe^{3+} and a 15% solution of NaOH was added to pH 8 to precipitate $Be(OH)_2$, $Al(OH)_3$, and $Fe(OH)_3$. Precipitates were washed 3 times with a solution of $(NH_4)_2CO_3$, and Be was dissolved as $(NH_4)_2[Be(CO_3)_2]$, which is decomposed by heating for 1.5-2 hours and causes precipitation of $BeCO_3 \cdot xBe(OH)_2$. The precipitate was filtered off and calcined at 850° to get BeO. To remove admixtures of Al^{3+}, Fe^{2+}, Mn^{2+}, Mg^{2+} (if beryllium is present as Be^{2+}) use was made of anionic ion-exchange resins which were then sprayed with 15% solution of $(NH_4)_2CO_3$. (OTS)

11802 ADSORPTION AND DESORPTION OF THORIUM, PLUTONIUM(III), AND PLUTONIUM(IV) IONS FROM A FILTER. Antoni Pasternak and Stanisław Lis (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 215-19(1961). (In English)

A study is made of adsorption and desorption of Th^{4+}, Pu^{3+}, and Pu^{4+} from a filter with respect to pH. A comparison is made of desorption curves, and the interpretation of analogies and differences is given. (auth)

11803 CATION—EXCHANGE SOLVENT EXTRACTION OF IRON. Tadeusz S. Urbański (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 299-308(1961). (In Polish)

Solvent extraction of Fe(III) with dodecyl phosphoric acid (DDPA) in the absence of other extractable metals was studied. From the DDPA saturation capacity determination for Fe(III) and from the slope of the curve log E^0_w – log [DDPA] it was postulated that in the organic phase mainly the compound $Fe_2(RPO_4)_3$ exists. Considering the partition isoterms of the Fe(III) between aqueous 1 N HCl, HNO_3, or H_2SO_4 solutions and 0.08 M DDPA in mepasine, it was found that the extraction is little effected by the type of the anion, and this effect does not exist at all if the ferric iron concentration is higher than 0.01 M. The extraction coefficient dependence on the initial metal concentration in aqueous phase is discussed along with the reverse proportionality at higher concentrations. It was found that the effect of acidity on the extraction of ferric iron is similar to that of uranium(VI). The plot of log E^0_w vs pH has the slope 0.3 or 0.1 for the pH range below and over 1.5, respectively. The diluents taken into consideration do not effect the partition of ferric iron. Only nitrobenzene has a strong diminishing effect. (auth)

11804 DIISOPROPYL ETHER EXTRACTION OF At FROM STRONG ACID SOLUTIONS IN PRESENCE OF OXIDIZING AGENT. Yung-yü Wang, and V. A. Khalkin. Radiokhimiya, 3: 662-6(1961). (In Russian)

It is shown that astatine can be extracted from nitric acid solutions by diisopropyl ether following oxidation at 25°C, from 12 M HNO_3 at 100°C, and from nitric, sulfuric, and hydrochloric acid solutions after Ce^{4+} oxidation at 100°C. In contrast to astatine the microquantities of I^{131} (without carrier) do not separate from strong mineral acids following Ce^{4+} oxidation. (R.V.J.)

11805 CALCULATIONS OF DISTRIBUTION OF MATERIALS IN COUNTERFLOW EXTRACTION. O. N. Shuvalov and M. F. Pushlenkov. Radiokhimiya, 3: 667-75 (1961). (In Russian)

An analytical method was developed for calculating equilibrium concentrations of substances extracted by cascade stages in counterflow processes. The analysis was tested in various extraction processes using TBP mixtures with a diluent. The method is illustrated with nitric acid and uranium extraction. The theoretical calculations are compared with experimental data. A method is also suggested for determining graphically the efficiency of individual extractor columns. (R.V.J.)

11806 EXTRACTION OF Pu FROM SULFURIC ACIDS BY AMINES. I. EXTRACTION OF SULFURIC ACID AND PLUTONIUM(IV) SULFATE BY n-TRIOCTYLAMINE. V. B. Shevchenko and Yu. F. Zhdanov. Radiokhimiya, 3: 676-84(1961). (In Russian)

An analyses are made of the influence of trioctylamine concentration on 2×10^{-4} M Pu(IV) extraction from sulfuric acid and of the influence of sulfuric acid concentration on the Pu(IV) distribution coefficient. Trioctylamine sulfate with an equilibrium constant $K_1 = 0.279 \times 10^7$ and TOA bisulfate with an equilibrium constant $K_2 = 1.18$ are formed in the organic phase during sulfuric acid extraction. It is shown that Pu(IV) sulfate distribution between sulfuric acid and TOA depends on the ratio of TOA sulfate and bisulfate concentrations. The distribution coefficient of Pu(IV) drops with increased relative TOA bisulfate concentration. It is also shown that the distribution coefficient of sulfuric acid and Pu(IV) increases with increased initial n-trioctylamine concentration. (R.V.J.)

11807 SOME QUANTITATIVE REMARKS ON EXTRACTION EQUILIBRIA. [PART] IV. M. Oosting (Ferro Enamels (Holland) N. V., Rotterdam). Rec. trav. chim., 79: 627-34(June 1960). (In English)

Two equations are derived, which predict the course of solvent extraction in the presence of complexing ions or when an insoluble compound can be formed. The correctness of the equations is proved for a few extraction systems. (auth)

11808 SEPARATION OF URANIUM AND ZIRCONIUM. (to U. S. Atomic Energy Commission). British Patent 891,436. Mar. 14, 1962.

An anhydrous process is outlined for separating U from spent reactor fuel elements containing U mixed with, alloyed with, or clad with Zr. The process comprises dissolving the fuel elements in a liquid acid fluoride solvent containing NO_2, separating the resulting insoluble Zr complex from the solution, evaporating the solution to dryness, reacting the residues with a liquid halogen fluoride to form volatile UF_6 and fission product fluorides, and separating UF_6 from the fission product fluorides by fractional distillation. The liquid acid fluoride may be HF or HPO_2F_2; in the case of HF, the NO_2 concentration is preferably 7 to 35 mole %. Some of the advantages of the process are that the dissolution is carried out at relatively low temperatures (~100°C), inexpensive materials may be used for the construction of process vessels, and the volume of waste fission products is minimized. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstract 11446

11809 (AERE-M-963) A VACUUM FURNACE FOR SINTERING AT TEMPERATURES UP TO 2400°C. K. E. Francis and N. Hodge (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1962. 11p.

A resistance-heated furnace capable of sintering at 2400°C in a vacuum of 10^{-5} mm Hg is described. The furnace element consists of a combination of tantalum and tungsten and gives a uniformly heated zone approximately 3 in. long by 0.75 in. diameter. Rapid heating and cooling times may be achieved. (auth)

11810 (AGC-0584-04-1) MERCURY CORROSION LOOP TESTING PROGRAM. First Quarterly [Progress Report], September 21–December 31, 1961. (Aerojet-General Corp., Azusa, Calif.). Mar. 1962. Contract NAS-3-1925. For National Aeronautics and Space Administration, Washington, D. C.). 10p.

The design of the corrosion loops was completed and drawings were released for use in fabrication. Fabrication of loop components and instrument procurement was initiated. The test facility was designed and the test cells were erected. Installation of the test cell exhaust system is nearly complete, and installation of electrical components is in progress. (J.R.D.)

11811 (BLG-64) DESIGN AND OPERATION OF THE PLUTONIUM CERAMICS LABORATORIES AT MOL. R. Billiau, B. Blumenthal, J. Draulans, and E. Vanden Bemden (Société Belge pour l'Industrie Nucléaire, Brussels and Brussels. Centre d'Etude de l'Energie Nucléaire). [nd.] 37p. (BN-610703)

A laboratory is described that is devoted to the study of Pu-containing fuel elements. The laboratory is designed to provide complete containment of α-emitters. Individual glove boxes are equipped for the preparation of U and Pu oxide compacts and for studies of their properties. The general layout of the laboratory, including its ventilation, power supply, leaktight glove boxes and their pressure control systems, filters, glove ports, connecting ports, and other pertinent details, is described. Elementary safety rules and first aid instructions are given. (auth)

11812 (CERN-62-7) A 200 KGAUSS PULSED MAGNET FOR EMULSION EXPERIMENTS. E. Brauners-reuther, J. C. Combe, L. Hoffmann and M. Morpurgo (European Organization for Nuclear Research, Geneva). Jan. 30, 1962. 30p.

A pulsed magnet was constructed which will give a magnetic field of ~200 kgauss over a volume of ~120 cm^3 with a variation of less than 3% and almost constant during the time of a proton burst. The measurements and calculations are discussed with respect to the requirements, and possible improvements are proposed. (D.L.C.)

11813 (CNI-100) SELECTION OF GAP THICKNESS FOR ISPRA IRRADIATION CANS. A. Gerosa and S. Moretti (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). Sept. 1961. 18p.

The first uranium specimens to be irradiated in the Ispra reactor will be contained in stainless steel cans each of which is placed in a second stainless steel can, with helium in the gap between the cans. In addition to the fission heating the specimens are electrically heated to achieve temperature control. Aluminum spacers are used to vary the width of the helium gap, thus altering the heat transfer conditions in the cans. The thickness of the spacers is chosen to give the required specimen temperature with the power available from the heater. The suggested thicknesses of the helium gaps are: 0.002 in. to maintain the specimens at 200° or 200° ± 50°C; and 0.050 in. to maintain the specimens at 550° or 500° ± 50°C. (auth)

11814 (GEAP-3787) RESULTS OF AIR–WATER AND STEAM–WATER TESTS ON RADIAL VANE STEAM SEPARATOR MODELS. J. I. Riesland (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). [1961]. Contract AT(04-3)-189. 47p.

Activities in a program are described to develop a compact radial vane-type separator for saturated steam–water mixtures. Design of the tests and models is described and results are given. Data indicate that the separators meet the requirements for boiling water superheat reactor application. Results also indicate that separator steam–water capacity can be predicted from air–water test results. Further development is recommended. (J.R.D.)

11815 (JINR-P-848) VOS MILITROVAYA VODORODNO-DEITERIEVAYA PUZYR'KOVAYA KAMERA V MAGNITNOM POLE. (Eight-Liter Hydrogen–Deuterium Bubble Chamber in Magnetic Field). T. D. Blokhintseva, A. T. Vasilenko, V. G. Grebinnik, V. A. Zhukov, G. Libman, L. L. Nemenov, G. I. Selivanov, and Jung-fang Yüan (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 20p.

A design of an 8-liter hydrogen-deuterium bubble chamber is described, and its operating characteristics are given. The chamber is a metal-glass device with the vertical location of its working volume. The chamber is illuminated by means of a lens. In the expansion system the bellows are used. The magnetic field is 12000 oersted in the working volume. The operating cycle of the chamber does not exceed 2 secs. (auth)

11816 (NAA-SR-5244) SNAP 2 REACTOR PUMP DEVELOPMENT PROGRAM (RADIAL GAP PERMANENT-MAGNET PUMP). S. Sudar (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 1, 1961. Contract AT-11-1-GEN-8. 50p.

A compact electromagnetic pump utilizing a rotating permanent magnet with radial gap was developed for possible application to the SNAP 2 reactor coolant system. The pump was designed for circulation of NaK at 1000°F and 11.2 gpm with a developed pressure of 3 psi, operation at 40,000 rpm, minimum weight and size, and high reliability. The performance characteristics of four developmental pump models were measured in a 1000°F NaK test loop and compared with design predictions. The capability of the pump design concept was demonstrated, though further development work is needed to meet the SNAP 2 pump requirements. A flow capacity of 6.8 gpm of NaK at 1000°F with a developed head of 3 psi with attained at a magnet rotor speed of 40,000 rpm. The weight of this pump is 3 pounds. Reasonable agreement was obtained between the actual pump characteristics and the design predictions. (auth)

11817 (NIRL/R/3) 24-ANODE PULSED POWER SUPPLY FOR MAGNET MODEL VI. A. J. Holt and J. D. Milne (Gt. Brit. National Inst. for Research in Nuclear Science.

Rutherford High Energy Lab., Harwell, Berks, England). Feb. 1961. 19p.

Details are given of the 24-anode mercury-arc rectifier-inverter used to supply a peak pulse power of 3.3 Mw to Magnet Model VI. Some special features of the design and operation of this power supply are discussed. (auth)

11818 (TID-14962) THE APPLICATION OF GAS-LUBRICATED BEARINGS TO HIGH-SPEED TURBOMACHINERY. Quarterly Technical Report, September 1, 1961 to November 30, 1961. M. W. Eusepi, A. Marmorou, and D. D. Fuller (Franklin Inst. Labs. for Research and Development, Philadelphia). Contract AT(30-1)-2512. 39p. (Q-A2392-3-3)

During the last quarter the component parts of the new self-acting bearing test rig (SA-2) and the modified parts of the externally-pressurized test rig, with only a few minor exceptions, were completely fabricated and inspected. Assembly has begun. The instrumentation for the tests was developed around a number of commercial instruments. The range of these instruments was extended and their sensitivity increased by modification of the electrical circuits. A complete description of the modification is included along with an analysis of the improved circuitry and the expected range of measurement and accuracy. A design theory was partially completed which will permit the analysis of the tilting-pad type of journal bearing including the effect of the compressibility of the gas that is serving as the lubricant. Prior to this, such analyses as were available were based on the hydrodynamics of incompressible flow. (auth)

11819 (NP-tr-852) STATISTICAL STRENGTH THEORY. S. D. Volkov. Translation of "Statisticheskaya Teoriya Prochosti" (a Publication of the State Publishing House of Scientific-Technical Literature on Machine Construction, Moscow, 1960). 363p.

A treatise is presented on the new statistical strength theory, which combines new methods for the computation of machine parts and equipment components with consideration of structural inhomogeneousness of technological materials. The practical application of the theory in the mechanical engineering field is discussed. (D.L.C.)

11820 ION SOURCES. Horst Loeb and Arthur Scharmann (Universität, Giessen, Ger.). Kerntechnik, 4: 1-7(Jan. 1962). (In German)

The different methods of producing ions are surveyed. Both gas discharge and surface-type sources were considered. Descriptions are presented of arc-discharge, primary-electron-collision, plasmation, Penning-discharge, anode-ray, thermal, surface-reaction, and high-frequency ion sources. (M.C.G.)

11821 THERMOELASTIC DYNAMICS OF RODS, THIN SHELLS, AND SOLID SPHERES. David Burgreen (United Nuclear Corp., White Plains, N. Y.). Nuclear Sci. and Eng., 12: 203-17(Feb. 1962).

The dynamic movements and stresses in fuel structures when subjected to a rapid temperature pulse were determined. The maximum expansion and stress produced in any of these elements is proportional to the magnitude of the temperature pulse, but also depends upon the ratio of the temperature pulse period to the natural period of oscillation. Parametric curves are plotted which show the dynamic expansions and stresses in these elements when they are subjected to temperature pulses of varying duration. (auth)

11822 IMPROVEMENTS IN OR RELATING TO GAS LUBRICATED JOURNAL AND JOURNAL BEARING ASSEMBLIES IN PUMPS. Stanley Whitley and David Shaun Allen (to United Kingdom Atomic Energy Authority). British Patent 891,039. Mar. 7, 1962.

A gas pump is designed which includes a gas-lubricated journal bearing and which has application in the monitoring of reactor gaseous coolants. The pump comprises a casing having an inlet and an outlet, and a journal and journal bearing assembly housed therein. The journal and bearing defines between them rings of part-circumferential viscosity grooves, each of which communicates at one end with the inlet and at the other end the outlet. (D.L.C.)

11823 IMPROVEMENTS IN OR RELATING TO APPARATUS AND METHODS, FOR SEVERING CASINGS CONTAINING SOLID MATERIAL. (to Commissariat a l'Energie Atomique). British Patent 891,204. Mar. 14, 1962.

An apparatus is designed for severing the casings of irradiated reactor fuel elements for subsequent processing. In the operation of the apparatus, the casing is clamped between jaws and likewise between further jaws, and the further jaws and the part of the casing engaged thereby is caused to rotate while the first jaws remain stationary, resulting in a cut of the casing. The apparatus may be operated remotely, e.g., immersed in water. (D.L.C.)

11824 IMPROVEMENTS IN OR RELATING TO PRESSURE VESSELS. Ronald Scott Challender and Jack Jones Griffiths (to United Kingdom Atomic Energy Authority). British Patent 891,508. Mar. 14, 1962.

A method for attaching a branch pipe to a pressure vessel to provide access to the interior is given which reduces the difficulties in cutting and welding. The method is especially useful when the angle between the bore axis and the tangential plane at which the pipe is attached is less than 30°. The method consists in increasing the thickness of the pipe in the neighborhood of the joint, so that the cylindrical surface of contact between the pipe and the vessel makes a greater angle with the tangential plane of the joint than that made by the bore axis itself. The cross section of the pipe in the area of increased thickness forms a hexagon. (D.L.C.)

11825 RADIOACTIVE SOURCE CONTAINER. James A. Commins (to Curtiss-Wright Corp.). U. S. Patent 3,026,414. Mar. 20, 1962.

A container is designed for storing and shipping radioactive sources and for replacing the source in radiographic cameras. The container comprises a block of shielding material within a housing and having at least one passageway leading to the outside. The passageway has a shielded position and an electrical switch for indicating the presence of a radioactive source in the shielded position and for positioning it there. (D.L.C.)

Heat Transfer and Fluid Flow

Refer also to abstract 12649

11826 (AEDC-TR-61-8) VERIFICATION OF A THEORETICAL METHOD OF DETERMINING DISCHARGE COEFFICIENTS FOR VENTURIS OPERATING AT CRITICAL FLOW CONDITIONS. Robert E. Smith, Jr. and Roy J. Matz (Arnold Engineering Development Center, Tullahoma, Tenn.). Sept. 1961. Contract AF40(600)-800. 56p.

When the accurate measurement of the flow rates of air or gases is required, the use of a venturi flowmeter which operates at critical flow conditions has certain advantages. A venturi contour designed specifically for use at critical

flow conditions is described, and a theoretical method is presented for determining the discharge coefficient of this venturi. An experimental investigation was conducted to determine the discharge coefficient of such a venturi, and the results are compared with the theoretical values. The investigation covered a range of Reynolds number from 0.4×10^6 to 5.4×10^6 based on venturi throat diameter. The venturi used had a throat diameter of 5.6436 in. and, therefore, an airflow capacity of 8.6 lb/sec at an inlet total pressure of one atmosphere and an inlet total temperature of 519°R. The values of discharge coefficient ranged from 0.992 to 0.994, and the theoretically and experimentally determined coefficients agreed within ±0.06% over the range of conditions investigated. (auth)

11827 (DC-60-5-57) GENERALIZED PRESSURE LOSS COMPUTATIONS FOR HEAT ADDITION TO AIR FLOWING IN CONSTANT AREA DUCTS. M. Lapides, R. Motsinger, J. Mullikin, and W. Prickett (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 11, 1960. Contract AT(11-1)-171. 30p.

Generalized data is presented for pressure loss in air, treated as a compressible fluid, flowing in a constant area, high friction duct. The graphs included conveniently lend themselves to the sizing and rating of air heat exchanger ducts and reactor coolant passages. The basic methods of graphics usage are readily apparent and require no explanation. Two groupings of parameters are presented; one to be used for establishing design, the other to be used in off-design. (auth)

11828 (DMIC-165) METHODS OF EVALUATING WELDED JOINTS. M. D. Randall, R. E. Monroe, and P. J. Rieppel (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Dec. 28, 1961. 78p. Contract AF33(616)-7747.

An analysis of the many test specimens used to evaluate welded joints is presented. The advantages and limitations of each specimen type are discussed. (auth)

11829 (EURAEC-177) RESEARCH ON VIBRATIONS AND HEAD LOSSES INSIDE TUBE BUNDLES. Quarterly Report No. 4, July through September 1961. (Societe Grenobloise d'Applications Hydrauliques, Grenoble, France). Oct. 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract 025-60-10-RDF-89. 14p.

In tests on tubular elements the effects of deflection in the vertical plane on the vibrational frequency within the same plane were examined. The effects of the location of force application on the frequencies for three moduli in tabular elements were also investigated. Tests on tubular clusters are also reported in which data were obtained on vibration in air and water. Similar air tests were carried out on a cluster of hollow elements. (auth)

11830 (NP-11313) HEAT BIBLIOGRAPHY, 1959. D. E. Sexton, ed. (Gt. Brit. National Engineering Lab., East Kilbride, Glasgow, Scotland). 1961. 411p.

A large number of references are presented on all aspects of heat: heat transfer, nuclear engineering, boiling, properties of substances, combustion, convection, fluid flow, heat exchangers, radiation, thermodynamics, etc. (D.L.C.)

11831 (SAN-1002) REACTOR HEAT TRANSIENT RESEARCH. Annual Summary Report, October 1, 1960–September 30, 1961. H. A. Johnson, V. E. Schrock, F. B. Selph, and S. Fabic (California. Univ., Berkeley. Inst. of Engineering Research). Nov. 1961. Contract AT(11-1)-34. 96p.

The mechanism of transient boiling heat transfer and steam void formation with transient heat input characteristic of nuclear reactors in the prompt critical range was studied. Progress is reported on the development of a high-pressure system and visual test chamber, instrumentation additions and modifications, visual test chamber results, the design of an x-ray densitometer, bubble growth study, and radiation capsule tests. (M.C.G.)

11832 (AEC-tr-5038) CRITICAL HEAT FLUX AND HEAT TRANSFER COEFFICIENT DURING BOILING OF LIQUIDS IN CHANNELS UNDER CONDITIONS OF FORCED FLOW. A. A. Ivashkevich. Translated from Teploenergetika, 8, No. 10, 74-8(1961). 13p.

Criterional equations are proposed for q_{kp} and α when liquids boil in channels under conditions of forced flow. The equations derived are compared with experimental data from various investigations. (auth)

11833 (FTD-TT-61-68) EFFECT OF INITIAL DISTURBANCES ON THE DEVELOPMENT OF TURBULENT STREAM CONDITIONS IN THE MOVEMENT OF AIR THROUGH TUBES. I. T. Shvets', E. P. Dyban, G. F. Sel'yavin, M. V. Strandoms'kii (Stradoms'kyy), S. K. Rudkin, and V. P. Mel'nik (Mel'nyk). Translated from Dopovidi Akad. Nauk Ukr. R.S.R., No. 2, 173-6(1960). 8p.

Experiments were conducted to study the development of axial velocity pulsations in an air stream in a tube at different levels of initial disturbances. The initial disturbances were induced by perforated disks mounted in the entrance of the tube, and the experiments were conducted at Reynolds numbers of 700 to 10,000. The results indicate that turbulence must be considered in calculation of heat exchange and hydraulic resistance in short tubes, that initial disturbances are dampened in relatively short segments whose lengths are a function of the initial disturbance level and Reynolds number, and that, at Reynolds numbers >5,000 in a tube 80 diameters long, the effects of the initial disturbances are negligible. (D.L.C.)

11834 EXPERIENCE WITH EXPERIMENTAL SODIUM HEAT TRANSFER CYCLE. Miroslav Pašek (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, [Prague]). Jaderná energie, 8: 43-50(1962). (In Czech.)

A heat transfer cycle (loop) containing 13 kg of sodium is described for heat transfer investigation of sodium streaming in tubes and for obtaining design and operational data of sodium heat transfer cycles. The fundamental elements of the loop are described along with the operational experience over a year's period. The operation failures of the loop are analyzed and discussed. From the results it is possible to construct and operate a sodium loop. (N.W.R.)

11835 THE PERFORMANCE OF METALLIC-FOIL INSULATIONS IN VERTICAL GAS SPACES. R. E. MacPherson, Jr. (Oak Ridge National Lab., Tenn.) and H. D. Stuart. Nuclear Sci. and Eng., 12: 225-33(Feb. 1962).

Gas-cooled reactor systems can benefit from the use of internal metallic-foil insulations which take advantage of the relatively low thermal conductivity of the coolant gas itself. Tests have shown that, for design purposes, Nusselt, Grashof, and Prandtl number correlations for vertical gas spaces form a good basis for finding optimum foil spacing and for approximating insulation performance. Tests were conducted chiefly on a spirally wrapped foil arrangement in which $\frac{1}{8}$ in. spacing between adjacent foil turns was maintained by strips of corrugated sheet metal 1 in. in width. Results from this arrangement in an atmosphere of helium have shown gross effective thermal conductivity values to be approximately 150% of the values for the gas itself at pressures below 200 psia. From 200 to 1000

psia, conductivity increases with pressure to values approximately twice those for the gas itself. For the specific geometry tested effective conductivity was shown to be a function of mean insulation temperature, gas pressure, temperature gradient across the insulant, and insulation thickness. (auth)

11836 AN ANALYSIS OF VAPOR VOID PROFILES IN HEATED CHANNELS. Gerald Houghton (Univ. of Pittsburgh). Nuclear Sci. and Eng., 12: 390-7(Mar. 1962).

The coupled nonlinear differential equations representing the void fraction and liquid temperature in a heated channel are solved by neglecting the slip velocity and assuming that there is no nucleation in the bulk liquid. In agreement with the experimental data for uniformly heated channels, the general solution of the void fraction equations predicts a sigmoidal vapor fraction profile. Theoretical temperature profiles show that, even in the high void fraction region, thermal equilibrium is not attained in the channel, indicating that the void profiles at high vapor fractions are still a complicated function of the liquid velocity, heat flux, vapor production, and channel spacing. (auth)

11837 CONDUCTING FLUID FLOW THROUGH RECTANGULAR TUBES IN MAGNETIC FIELD. G. A. Grinberg (Inst. of Physics, and Tech., Academy of Sciences, USSR). Priklad. Mat. i Mekhan., 26: 80-7(Jan.-Feb. 1962). (In Russian)

An equation was derived for conducting steady fluid flow through a rectangular tube with two non-conducting walls and two-conducing walls parallel to an external magnetic field. Also, a new solution was found for the Shercliff problem of fluid motion through a tube with non-conducting walls. The data can be utilized with large Hartman numbers. (R.V.J.)

11838 ON THE ARBITRARY FLOW DISCONTINUITY IN MAGNETOHYDRODYNAMICS. V. V. Gogosov. Priklad. Mat. i Mekhan., 26: 88-95(Jan.-Feb. 1962). (In Russian)

The problem of shear flow discontinuity in magnetohydrodynamics, with a magnetic field transverse to the discontinuity plane and arbitrary parameters on both sides of the discontinuity, was analyzed. A possible 120 discontinuity events are estimated, and the discontinuity events possible in relation to initial parameter magnitudes are indicated. (R.V.J.)

11839 TWO-PARAMETER FLOW IN MAGNETOGASDYNAMICS. (GROMEKA AND CHAPLYGIN TRANSFORMS). V. S. Tkalich (Inst. of Physics and Tech., Academy of Sciences, Georgian SSR). Priklad. Mat. i Mekhan., 26: 96-103(Jan.-Feb. 1962). (In Russian)

A system of equations for magnetohydrodynamics in stationary two-parameter flow, in the absence of a magnetic field in a selected direction, was reduced with the aid of an I. S. Gromeka transform to a two-scaler equation with two scalar functions. For vortex motion, the derived system is further reduced to a linear system by means of Chaplygin transformation. The principle physical properties were studied, and conditions for their ellypticity were found. (R.V.J.)

11840 ON THE STABILITY OF A PLAIN LAYER OF GRAVITATIONAL FLUID WITH EXPONENTIALLY DECREASING DENSITY IN PRESENCE OF MAGNETIC FIELD. V. A. Vardanyan and R. S. Oganesyan (Erevan State Univ., USSR). Priklad. Mat. i Mekhan., 26: 104-9 (Jan.-Feb. 1962). (In Russian)

The stability of a plain gravitational fluid layer with an internal magnetic field parallel to the layer, an exponentially decreasing density, and with surface perturbations is analyzed. (R.V.J.)

11841 ON THE NON-STATIONARY FLOW OF CONDUCTING FLUID THROUGH A TUBE OF CONSTANT CROSS-SECTION IN TRANSVERSE MAGNETIC FIELD. Ya. S. Uflyand (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 31: 1409-19(Dec. 1961). (In Russian)

An analysis is made of nonstationary flow of conducting, viscous, incompressible fluid in an infinitely long tube in an external, uniform, transverse magnetic field. The general aspects of flow in tubes of arbitrary cross section, with conducting or non-conducting walls and mixed boundary conditions, and in round tubes with non-conducting walls are analyzed. (R.V.J.)

11842 STEADY LAMINAR FLOW OF CONDUCTING FLUID IN RECTANGULAR TUBE UNDER PONDERMOTOR FORCES. A. G. Ryabinin and A. I. Khozhainov. Zhur. Tekh. Fiz., 32: 15-21(Jan. 1962). (In Russian)

Integrated Navier-Stokes equations and electrodynamics of slowly moving media were used for determining the distribution rate in steady, laminar flow of conducting fluid in a rectangular tube under ponderomotive forces. The derived solution is unique. Expressions are also found for the mean rate of flow and tube friction losses. The results were correlated with Hartman and Lazarus data and with previous experiments. (R.V.J.)

Instrumentation

Refer also to abstracts 11956 and 11966

11843 (AD-259169) FIRST QUARTERLY PROGRESS REPORT ON FIBER RADIACMETER IM-122( )/PD, JULY 1, 1960 TO OCTOBER 31, 1960. (Bendix Corp., Cincinnati). Oct. 31, 1960. Contract DA-36-039-SC-84986. 88p. (R-60-CDE-01-6)

The design of the fiber radiacmeter IM-122( )/PD was divided into 3 paralleling efforts. These include the rate-indicating function complete with zero surveillance, the power supply and associated battery charger, and housing and exterior controls. The design plan considers each of the primary functions both independently and in their proper relationship. Correlating functions were studied from the standpoint of maximum utility as well as performance. Efforts were concentrated on the radiation rate detection and indicating function. Experimental studies coupled with a mathematical analysis are given with a view toward determining optimum boundary values for all parameters. A transistorized d-c to d-c converter type of power supply was designed. Detailed procedure for the design and construction of the engineering test model of the radiacmeter is presented. (auth)

11844 (AD-259711) EXPERIMENTAL AND RESEARCH WORK IN NEUTRON DOSIMETRY: PHASE I. Final Summary Report, July 1, 1960 to February 28, 1961. H. C. Gorton, O. J. Mengali, J. M. Swartz, A. E. Mace, and C. S. Peet (Battelle Memorial Inst., Columbus, Ohio). Mar. 31, 1961. Contract DA 36-039-SC-78924. 48p.

Research was concerned with the development of a dosimeter system which will ultimately provide a capability for measuring fast-neutron dosage in terms of biological damage to personnel exposed to nuclear radiation under tactical conditions. Four areas investigated were material supplier, minority-carrier life-time in the material before processing, modifications of the processing technique to retard degradation of lifetime in processing the device, and the width of the base region of the detector. The results of experiments on devices made from high-resistivity silicon, low-oxygen-content silicon, and with a deep p-p^+ junction showed that none of these innovations

resulted in a significantly improved device. An annealing treatment of selected detectors exposed to a fast-neutron dose of 1178 tissue rads resulted in the recovery of greater than 90% of the preirradiation characteristics. The relative scatter in the lifetimes of the 15 detectors studied in this experiment decreased appreciably after annealing above 250°C. Brief consideration was given to package requirements imposed by the electronic, radiological, environmental and physical properties of the detector. (auth)

11845 (AD-261503) GAMMA RAY CRYSTAL DOSIMETRY. Otto Renius and Donald W. Rees (Detroit Arsenal. Physical Sciences Lab., Center Line, Mich.). Apr. 1961. 23p. (RR-39)

BT cut quartz oscillator plates were subjected to Cs^{137} and Co^{60} gamma radiation up to total doses of 2.4 Mr. The radioinduced frequency shifts of the crystals were measured as functions of incident gamma ray energy, total dose, and dose rate. The crystals were studied over a six-month period to note any recovery from radiation effects as measured by frequency shift. The results indicate that the frequency is lowered with irradiation; on aging for an extended period after irradiation, the crystal tends to return to its original frequency; the dose rate does not have an effect on the frequency for a given total dose; the extent of damage is affected by the gamma energy; and the extent of damage varies from crystal to crystal for the same fundamental frequency owing to impurities. (D.L.C.)

11846 (ARF-1192-3) A STUDY OF THE FEASIBILITY OF USING SCINTILLATING FIBERS FOR LOW ENERGY BETA COUNTING. Quarterly Report No. 1, June 15, 1961–September 14, 1961. C. Preston (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 5, 1962. Contract AT(11-1)-578. 6p.

Design features of a scintillation detector using hexagonal close-packed bundles of scintillating fibers are described. A 2π geometry is approached by dispersing the sample in the voids between the individual fiber strands. Careful selection of the photomultiplier tube, preamplifier, and amplifier assure low noise and high gain, which are necessary for low-energy-β counting. (T.F.H.)

11847 (CREL-957) A TRANSISTOR DECADE-SCALER USING A COLD-CATHODE INDICATOR-TUBE DISPLAY. J. Leng and J. C. Irvine (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Sept. 1961. 38p. (AECL-1431)

A numeric, in-line, decimal display is described that uses a cold-cathode indicator tube for each decade. Because the binary-to-decimal decoding circuitry is more extensive than each decade, a time-sharing system is used whereby one decoding circuit is used to decode the decades sequentially. The decoding circuit is of the transistor-decoding-tree type. (T.F.H.)

11848 (DC-60-12-149) FISSION PRODUCT RELEASE DETECTOR. J. J. Baum, G. M. B. Bouricius, and G. K. Rusch (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 29, 1960. Contract AT(11-1)-171. 7p.

A proposed system is described for detecting changes in the radiation level in the effluent duct of a direct-cycle nuclear reactor power plant in the presence of a large and varying background radiation from the reactor. Radiation from fission products in the coolant stream is identified by its state of motion in the effluent duct and the consequent time relations between signals from two radiation sensors located in the duct. (auth)

11849 (DP-668) AN AUTOMATIC GAS CHROMATOGRAPH FOR MONITORING OF REACTOR FUEL FAILURES. PART IV. MODEL 2 DESIGN. William R. Kritz (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Jan. 1962. Contract AT(07-2)-1. 30p.

The construction, installation, and operation of an automatic gas chromatograph are described. This instrument provides reliable monitoring for fuel element failures by routine analysis of radioactive gases in operating reactors. Sufficient design details are included to permit duplication of this instrument, or modification of the design to meet specific requirements. (auth)

11850 (DRCL-355) THE SATURATION CURVE IN IONIZATION CHAMBERS. P. A. Tate and P. C. East (Canada. Defence Research Chemical Labs., Ottawa). Oct. 1961. 24p.

The form of the saturation curve has become of interest because of recent use of unsaturated ion chambers. A review of previously developed formulas for the saturation curve is given and it is shown that all these formulas may be expressed in terms of a ratio of two parameters of simple physical significance. Experiments with parallel plate ionization chambers show the form of the curve to be in good agreement with Mie's theoretical saturation curve but that the values of constants used to obtain a fit depend somewhat on the construction of the chamber. The experimental saturation curve was found to be independent of energy and dose rate over a considerable range of these quantities. A formula was developed for the mean of the two saturation curves of opposite polarity in a coaxial cylindrical ionization chamber in the unsaturated region. (auth)

11851 (GEL-0702) THE CHROMEL A VS. NO. 875 ALLOY THERMOCOUPLE SYSTEM FOR FUEL ELEMENT TEMPERATURE MEASURMENTS. Summary Report. A. I. Dahl (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Nov. 17, 1959. Contract AT(11-1)-171. 45p.

The Chromel A vs. #875 thermocouple system was evaluated for measuring surface temperatures of Nichrome-clad fuel elements. Calibration studies were carried out on bare and sheathed thermoelements, and the effects of a hydrogen braze cycle and aging on the calibration were studied. It is concluded that the thermocouple system is stable and dependable. (D.L.C.)

11852 (IDO-16715) DESIGN OF AN AUTOMATIC FOIL COUNTING DATA SYSTEM. R. I. Little (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Jan. 26, 1962. Contract AT(10-1)-205. 22p.

The design of a system which automatically counts radioactivity up to 500 samples and produces a data record suitable for automatic processing is described. The system processes two samples simultaneously while a third provides a time base for half-life decay correction. Each data record includes identification, elapsed time, count time, and the counts accumulated in the three counting channels. The system employs solid state circuit modules and electromechanical devices selected so as to obtain a life expectancy of ten years. The use of solderless connections wherever possible results in better reliability, economy, neatness, and ease of modification. (auth)

11853 (IFA-RS-15) STABILIZATOR CHASTOTY MIKROVOLNOVOGO GENERATORA. (Frequency Stabilizer for Microwave Generator). I. Paskaru (Academia R. P. R. Institutul de Fizica Atomica, Bucharest). 1961. 5p.

Stabilization of a klystron generator at 9270 Mc was achieved by comparing the klystron frequencies with the harmonics of a quartz generator. Such stabilization was found advantageous due to its relatively simple electronic scheme and the ability to transfer the quartz generator stability to the klystron. (R.V.J.)

11854 (NP-11366) A HELIUM MAGNETOMETER THAT UTILIZES LIGHT-MODULATION (thesis). Robert G. Aldrich (Varian Associates, Palo Alto, Calif.). 1961. 81p.

Submitted to Naval Postgraduate School, Monterey, Calif.

The theory of a helium magnetometer that utilizes a modulated pumping light is presented, and the equipment used to construct an experimental magnetometer system is described. The feasibility of this system as an instrument to measure changes in the earth's magnetic field is confirmed. (auth)

11855 (NP-11377) CHARACTERISTICS OF ION DRIFTED P-I-N JUNCTION PARTICLE DETECTORS. J. W. Mayer, N. A. Baily, and H. L. Dunlap (Hughes Aircraft Co., Culver City, Calif.). [1961]. 35p.

[Presented at] Conference on Nuclear Electronics, International Atomic Energy Agency, Belgrade, Yugoslavia, May 15-20, 1961.

Ion drift techniques are used to produce p-i-n junction particle detectors by drifting lithium in p-type silicon. Depletion widths greater than 4mm are obtained. Agreement is found between calculated and measured drift rates. In these junctions the predominant contribution to the d-c reverse current is caused by thermally generated carriers in the depletion region. At elevated temperatures the space-charge of thermally generated carriers on the field causes a change from the room temperature capacitance-voltage relations. Although the response of the p-i-n junction to gamma rays is dominated by the Compton electron energy distribution, photopeaks can be observed. The sensitivity to gamma rays follows a $1/r^2$ dependence. Typical energy resolutions are 1 and 4%, for 17-Mev deuterons and 1800-kev electrons, respectively. (auth)

11856 (NP-11386) THE STUDY OF PROPERTIES OF SINGLE CdS AND ZnS CRYSTALS FOR USE AS DETECTORS IN CRYSTAL COUNTERS. Technical Report No. 7. Herbert Payne and W. M. Baker (Detroit. Univ. Research Inst. of Science & Engineering). Feb. 1, 1962. Contract Nonr 1511(01), NR 015-218. 15p.

A system in the ground state consisting of a large number of independent Fermi-Dirac particles was investigated to predict its properties. The possible dependency of the particle density on the intermediate function $P(E_m,x)$, which is a solution of $P^2 + (P''/2P) - 3/4(P'/P)^2 = E_m - V$, was studied. A statistical formula containing P is proposed for the particle density and was tested for the examples of a square well potential, a linear potential, and a harmonic oscillator potential ($V = x^2$ and $N = 3$). The density equation was found to give the same results as those derived from wave mechanics. (D.L.C.)

11857 (NRL-5744) THE NRL AUTOMATIC SINGLE-CRYSTAL, NEUTRON DIFFRACTOMETER. E. Prince (Naval Research Lab., Washington, D. C.). Dec. 28, 1961. 17p.

An automatic diffractometer for the study of the physics of crystalline solids by means of neutron diffraction was completed. It was designed for maximum versatility in studying the structure of materials, with special emphasis on magnetism, but also with an emphasis on metallurgical and structural chemical problems. On the basis of the initial experiments it appears that useful diffraction data is possible from crystals as small as 1 mm^3, although 10 mm^3 is probably a more suitable size. Automatic programming brings the specimen crystal into the position for reflection and rotates the crystal and counter through the Bragg angle by independent adjustments, each of which is provided with an electrical readout to a digital recorder. A computer program does all preliminary processing of data tapes. (auth)

11858 (ORNL-3191) INSTRUMENTATION AND CONTROLS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 1, 1961. (Oak Ridge National Lab., Tenn.). Feb. 19, 1962. Contract W-7405-eng-26. 110p.

The report comprises seven sections. A separate abstract was prepared for each section. (J.R.D.)

11859 (ORNL-3191(p.1-18)) ELECTRONICS. A. M. R. Ferrari, C. W. Williams, et al., (Oak Ridge National Lab., Tenn.).

A method was developed for determining the theoretical limits on amplification and band width for linear voltage amplifiers. Testing is reported to determine the pulse characteristics of phototubes, and development of nuclear spectroscopic prototype instruments is described. Magnet d-c power supplies are being installed in the Oak Ridge Isochronous cyclotron. Development of a Geiger-Mueller survey meter to operate in gamma intensities up to 500 r/hr is reported along with a portable fast-neutron survey meter for measurements in moderately high gamma fields. A portable gamma monitor was developed for aerial use in high levels of radiation resulting from nuclear disasters. A radiation monitor was also developed having normal operation at low gamma dose rates and large over-range for use in monitoring the ORR secondary system. (J.R.D.)

11860 (ORNL-3191(p.19-35)) NUCLEAR-RADIATION DETECTION AND MONITORING. J. L. Blankenship, C. J. Borkowski, et al. (Oak Ridge National Lab., Tenn.).

The design of a Si surface-barrier nuclear-particle detector and a surface-barrier diode assembly for fast-neutron spectroscopy are described. An investigation of the light-piping behavior of Lucite showed that with $1\frac{1}{2}$-in.-thick light paper, the pulse amplitude at $3\frac{1}{2}$ in. from the center of the paper was about 35% of the pulse amplitude at the center. Construction of a vacuum chamber for alpha counting is reported, and a description of instrumentation for the whole-body counter facility is given. Other development includes low-level beta-gamma personnel monitors, and monitors for airborne alpha-emitting and beta-gamma emitting particles. Participation in instrumentation for modification of laboratory, reactor, and other facilities for radioactivity containment is described. Modification of water monitoring instrumentation and gaseous-effluent monitoring equipment are reported. (J.R.D.)

11861 (ORNL-3191(p.36-45)) DATA HANDLING AND COMPUTATION. Daniel Hampel, B. J. Moore, et al. (Oak Ridge National Lab., Tenn.).

Design of an automatic data-readout system for preparation of data from a Cary recording spectrophotometer is reported. The output data is punched on IBM cards for computer processing. In other work, development of an automatic data handling system for evaluation of strip-chart potentiometer recorders is reported and application of a data-logging system to the volatility Pilot Plant is discussed. Measurements made in HRT core-model flow experiments using a special-purpose analog computer are described. (J.R.D.)

11862 (ORNL-3191(p.46-65)) PROCESS CONTROL AND INSTRUMENTATION. C. S. Lisser, G. W. Allin, et al. (Oak Ridge National Lab., Tenn.).

The status of instrumentation for the High Radiation-Level Laboratory is reported along with modifications for instrument systems used in the Fission Products Laboratory. Design of a W–Re thermocouple for control temperature measurement in hollow UO_2 pellets is described. Results of tests using He and N to determine the feasibility of using gas thermodynamics as a basis for high-temperature measurement show good precision. Conclusions from testing 11 strip-chart recorders are listed. (J.R.D.)

11863 (ORNL-3191(p.66-88)) REACTOR-CONTROLS-SYSTEMS DEVELOPMENT AND DESIGN. S. H. Hanauer, L. C. Oakes, et al. (Oak Ridge National Lab., Tenn.).

A new group of reactor-control instruments is being developed. These systems are based on the concepts of redundancy, coincidence, and testing. Development of a miniaturized fission chamber and preamplifier for use in high-flux reactors is reported along with a reactor-power monitor which uses Čerenkov radiation. Control instrumentation for the Fast-Burst Reactor at reactivities above prompt critical are discussed. Proposed instrumentation for the MSRE is described along with process instrumentation for High Flux Reactor cooling systems. (J.R.D.)

11864 (ORNL-3191(p.89-91)) SUPPORT FOR THE HIGH-VOLTAGE ACCELERATOR PROGRAM. W. T. Newton, J. P. Judish, et al. (Oak Ridge National Lab., Tenn.).

Construction and installation of a pulsed terminal for the 5-Mv Van de Graaff accelerator is reported. A 1000-hr test in which terminal component cooling was achieved with Freon 113 was successful. Construction of a molecular-beam Li evaporator and target assembly is reported. A system of post-acceleration was developed for the 3-Mv Van de Graaff along with a duoplasmatron ion source for this accelerator. (J.R.D.)

11865 (ORNL-3191(p.92-101)) MISCELLANEOUS [INSTRUMENTATION]. W. W. Johnston, Jr., H. J. Stripling, Jr., et al. (Oak Ridge National Lab., Tenn.).

Development of a high-temperature calibration furnace for 2200°C operation is reported. In other work, development of an adiabotic calorimeter for aqueous systems is in progress, and development of a stable millivolt reference supply was completed. (J.R.D.)

11866 (TID-14134) AN INDUCTION CONDUCTIVITY TEMPERATURE INDICATOR. Technical Report XXV. E. W. Schiemer and D. W. Pritchard (Johns Hopkins Univ., Baltimore. Chesapeake Bay Inst.). Oct. 1961. Contracts Nonr 248(20) and AT(30-1)-1477. 90p.

The design, construction, and operational characteristics of the induction conductivity-temperature indicator (ICTI) are described. The ICTI consists of two self-balancing digital direct readout indicators, with underwater sensing elements. A voltage is induced in sea water by transformer action and the induced current is measured with a second transformer, the voltage output of which is a function of conductivity. Temperatures are sensed by a thermistor bead having a time constant of less than one second. Accuracy of the measurements were: ±0.02°C for temperature; ±0.02 mmhos/cm for conductivity; and ±0.03% for salinity. (B.O.G.)

11867 (TID-15128) SCINTILLATION RESPONSE OF CRYSTALS. E. J. Zimmerman and J. M. Bunch (Nebraska. Univ., Lincoln). 1962. Contract AT(11-1)-35. 14p.

Data were obtained for the response of anthracene and a plastic scintillator to protons with energies around the maximum in the stopping power for the respective materials. The measuring method consisted of chopping the proton beam and synchronously detecting the resulting pulses. The diagrams for the electronic circuits are shown. The results, although difficult to duplicate, seemed to indicate that the light output per incident current plotted against energy has an inflection at the maximum in the stopping power, as would be expected from Birk's theory. The points were taken starting at low energies and going up. After reaching the highest energy, the point at 50 kev was repeated and found to be about 10% low, which may be the result of radiation damage. (M.C.G.)

11868 (USNRDL-TR-544) A QUALITATIVE STUDY OF RADIO-FREQUENCY INTERFERENCE IN RADIAC-TELEMETRY SYSTEMS. H. A. Zagorites and D. Y. Lee (Naval Radiological Defense Lab., San Francisco). Feb. 8, 1962. 20p.

With the need for radiological data for military purposes and public safety, radio telemetry may be used extensively in the transmission of radiological information. The use of radio telemetry in nuclear radiation measuring systems introduces potential radio-frequency interference (RFI) problems in the detector elements of the system, due to the telemetry transmitter, and in the reception process, due to noise. Also, data accuracy may be reduced by the bandwidth limitation of the telemetry system. In an effort to better understand the effects of RFI and bandwidth limitation on data accuracy and reliability, a number of qualitative tests were made with an existing recycling electrometer type of radiation recorder coupled to a standard telemetry system. These tests, which showed that significant errors can result from RFI, demonstrated the need for system designs which minimize radio-frequency (r-f) coupling to the high impedance elements of the radiation detector and circuitry. RFI in the radiation recorder tested caused an increase in the recycling period of 20% or more under some conditions. This increase was attributed to the recharging of the radiation detector by the r-f through the diode action of the electrometer tube. Also, it was found that the effect of bandwidth limitation on the transmitted pulse output of the recorder was small and that the system accuracy was not significantly lowered. However, system noise reduced reliability at very low pulse repetition rates. The test results showed that potential RFI problems exist in radiac-telemetry systems. Most of these problems can be met satisfactorily through the use of common r-f elimination techniques. (auth)

11869 (WCLT-TM-59-115) HIGH INTENSITY GAMMA RAY DOSIMETRY. R. E. Brocklehurst (Wright Air Development Div. Materials Lab., Wright-Patterson AFB, Ohio). Dec. 30, 1959. 25p.

Results are presented concerning research on dosimetry systems for use in determining materials radiation effects. Five chemical systems for dose measurement and three physical systems which are dose rate devices are described. Several of the systems are considered useful, and it is noted that choice of a particular system depends on the demands of the application. (J.R.D.)

11870 (AEC-tr-5041) MEASUREMENT OF QUANTUM RADIATION IN THE ENERGY RANGE FROM 3-30kev BY MEANS OF LARGE-AREA PROPORTIONAL COUNTING TUBES. H. Fessler, H. Kiefer, and R. Maushart. Translated by Lydia Venters (Argonne National Lab., Ill.) from Atompraxis, 7: 401-7(Nov. 1961). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 4337.

11871 (NP-tr-833) THE CONSTRUCTION OF THE EFFECTIVE VOLTAGE DIAGRAM OF CONTINUOUS

X RAYS AND DETERMINATION OF THE DEGREE OF MONOCHROMATISATION BY SPECTRAL ANALYSIS. K. Minami (Japan Atomic Energy Research Inst., Tokyo). Translated by L. Allen (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from p.243-6 of report JAERI-5002. 1961. 12p.

A discussion is given of a method for obtaining an effective voltage diagram for continuous x rays by filtering the x rays produced. When the homogeneity is sufficiently high there is no great change in effective energy and half-width even where the filter plate thickness changes. It was found undesirable to use lead as the filter plate because of its scattering properties and the effect of the K series. The reproducibility of the results can be improved by controlling the tube voltage. (B.O.G.)

11872 A SIMPLE ATTACHMENT FOR OPERATING A COUNTING IONIZATION CHAMBER. F. Hawliczek (Krankenhauses der Stadt, Vienna-Lainz). Atompraxis, 8: 63-5(Feb. 1962). (In German)

A simple attachment, which makes it possible to operate a 4π ionization chamber in connection with a counter, is described. The counter supplies voltage for the ionization chamber and the attachment, and also serves as a timer. Radioactive isotopes can be measured accurately with this arrangement. Measurement reproducibility is extremely good, with an error of less than ±5%. The simplicity of the attachment makes it dependable in operation. It can be used in connection with any counter whose timing mechanism can be externally controlled. If a proper counter is available, the attachment provides a cheap substitute for expensive measurement amplifiers with an electrometer amplifier or vibrating condenser. In the form described, it can be used for doses from 0.5 to 500 mc. (auth)

11873 NUCLEAR INSTRUMENTATION NO. 9. Bull. inform. sci. et tech. (Paris), No. 56, 39-65(Nov. 1961). (In French)

The ninth issue is devoted to functional components used in nuclear instrumentation. After a description of standardized equipment adopted at the C.E.A. either as functional plug-in units or complete assemblies, recent modifications brought to scintillation detectors, low noise level preamplifiers (type PFB 10), and proportional amplifiers (type APT.21) are given. (auth)

11874 THE EFFECT OF THE FORMATION OF A DIRECTED BEAM OF IONS IN A TRIPLE-PLATE ION SOURCE OF A MASS-SPECTROMETER. M. S. Chupakhin and E. Gradshtain (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Doklady Akad. Nauk S.S.S.R., 142: 337-9(Jan. 11, 1962). (In Russian)

A thermionic ion source with three plates which could be heated simultaneously was used to increase the sensitivity of detection of a mass-spectrometer for small amounts of material formed in a nuclear reaction. Any one of the plates could be used as a vaporizer, while the other two plates were used as ionizers. It was found that the total ion current produced by the same amount of material varied widely depending on which plate was used as a vaporizer. The kind of chemical compound employed had no effect on the ion yield. Elements with two valence electrons such as Ba, Sr, V, Mg, Co, Fe, and Mn gave much larger ion currents on being vaporized from plates 2 or 3. Li, Al, Cr, Cu, Re, and In which have 1 or 3 valence electrons, gave high ion currents on being evaporated from plate 1. Thus, the simultaneous analysis of Rb and Sr is made more difficult, since Sr is evaporated preferentially from plate 2 or 3, and Rb hardly forms any ions from this plate. Evaporation of an element from the proper vaporizer results in high sensitivity, while evaporation from the "wrong" vaporizer results in sharply decreased sensitivity. At present, there is no satisfactory explanation for the difference in behavior of various elements, but this fact can be utilized in analytical work to increase the sensitivity of detection of small amounts of material in a substance. (TTT)

11875 CAMERA AND AMPLIFIER FOR THE MEASUREMENT OF IONIZATION CURRENTS PRODUCED BY ALPHA RAYS. José Luis de Briones. Energia nuclear (Madrid), 5: 57-67(July-Sept. 1961). (In Spanish)

An instrument consisting of an ionization chamber and an electronic amplifier, which is designed for the measurement of ionization currents, is described. The factors prejudicial to the operation of the chamber are analyzed with a quantitative evaluation of the saturation thresholds for recombination and space charge; the spontaneous ionization caused by cosmic radiation is determined and negated by means of a second compensating chamber. The characteristics of the vacuum tubes and the direct-coupling amplifiers are described, and the total amplification of the apparatus is determined. The sensitivity of the instrument permits ionization currents of 2×10^{-18} amp to be measured. (tr-auth)

11876 SCINTILLATION SPECTROMETRY OF CONTINUOUS γ-RAY. Kenji Ishimatsu (Hitachi Central Research Lab., [Tokyo]). J. At. Energy Soc. Japan, 4: 24-30(Jan. 1962). (In Japanese)

A response circuit which converts scintillation pulse height spectra to incident photon spectra is presented. The circuit is applicable for broad parallel γ rays up to 1.5 Mev incident to a 2 by 2 in. diameter sodium iodide crystal. Reliability of the matrix is estimated by experimental pulse height spectra from a Cs^{137} source. The resultant error in the energy channel is estimated as 5% of the number of incident photons, which have energies higher than the energy of the channel. A correction to incident γ rays of uniform angular distribution is also discussed. (auth)

11877 MULTICRYSTAL LARGE WELL COUNTERS. B. Cassen (Univ. of California, Los Angeles). J. Nuclear Med., 3: 128-35(Mar. 1962).

Design, construction, and performance are described of a multicrystal large well counter. Irregular pieces of thallium-activated sodium iodide are immersed in a suitable fluid and arranged in an approximately two inch thickness around the space containing the sample. A diagrammatic section of the counter and photographs of the components and complete counting assembly are included. (C.H.)

11878 NOVEL THICKNESS GAUGES. J. Guizerix (Centre d'Études Nucléaires, Grenoble, France). Kerntechnik, 3: 534-6(Dec. 1961). (In German)

Gauges which allow the determination of thickness by measuring the absorption of atomic radiation in a sample are described. Stabilization offers the most serious difficulties in the design of such instruments. Some examples show how stabilization was achieved in several cases. (auth)

11879 THE ROTATING DISC METHOD–AN IRRADIATION PROCEDURE AT THE FRM. W. Marth. Kerntechnik, 3: 543-4(Dec. 1961). (In German)

An instrument with which samples can be irradiated homogeneously in the inhomogeneous neutron field outside a reactor is described. (auth)

11880 EXPERIMENTAL DETERMINATION OF THE HALF-VALUE LAYER FOR SOFT BETA-RADIATION

AND DETERMINATION OF THE THICKNESS OF THE GAS-COUNTER WINDOW. R. S. Mil'shtein (State Scientific-Research Roentgen-Radiological Inst., Ministry of Public Health, USSR). Med. Radiol., 6: No. 11, 63-6 (Nov. 1961). (In Russian)

A technique is described for determining the half-value layer for soft beta-radiation in air by means of two measurements. A method is also given for determining the thickness of a gas-counter window without its destruction, using a standard beta-active preparation. (auth)

11881 X- AND GAMMA-RAY CALIBRATION. Fifth in a Series on NBS Measurement and Calibration Services. Natl. Bur. Standards (U. S.), Tech. News Bull., 45: 116-18 (July 1961).

Instruments used as laboratory standards for measurements of x rays emitted at tube potentials of 20 to 250 kv and gamma from Co^{60} are calibrated. Equipment and procedures are described. (L.N.N.)

11882 A TIME-OF-FLIGHT SPECTROMETER FOR FAST NEUTRONS. P. Huber, Z. Lewandowski, R. Plattner, C. Poppelbaum, and R. Wagner (Univ. of Basel). Nuclear Instr. & Methods, 14: 131-7(Dec. 1961). (In English)

A time-analyzer for the nanosecond range with correction of the amplitude-effect in the start channel is described. The output of a time-to-pulse-height converter is corrected by adding a signal depending on the amplitude of the start pulse. Using two 56-AVP phototubes and NE-102 plastic scintillators (42 mm diameter, 25.4 mm length) the half-width of a prompt Co^{60} $\gamma - \gamma$ coincidence curve is found to be 6.5×10^{-10} sec. The variation of the time resolution over a start-level range from 150 to 900 kev electron energy is less than 1×10^{-10} sec. In order to increase the detection efficiency of the time analyzer for applications in neutron spectroscopy the 56-AVP in the start channel is replaced by the larger tube 58-AVP (NE-102, 125 mm diameter, 25.4 mm length), and a resolution of 8×10^{-10} sec is obtained at a start-level of 70 kev. A method of producing ion-bursts in the nanosecond range is described. The deuteron beam of a Duo-Plasmatron is periodically defocused by means of a 4-Mc HF-generator modulating the extraction voltage of the ion-source. By proper adjustment of the geometry and the HF amplitude, time focusing on the target is achieved. By this method much more intense ion-bursts can be achieved than by beam-chopping. Peak currents of 3 ma are realized with a burstwidth of 3 nsec. (auth)

11883 EXPERIMENTAL DETERMINATION OF SUMMING DISTRIBUTIONS IN SCINTILLATION DETECTORS. G. B. Vingiani and S. Monaro (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nuclear Inst. & Methods, 14: 138-42(Dec. 1961). (In English)

A modification of the Hoogenboom summing method is used to determine the pulse height distribution of summing peaks in NaI(Tl) crystals. The fast coincidence circuit is triggered by time coincident events in two equal crystals and the sum of the two pulses displayed on a multichannel analyzer. These distributions are obtained for a number of standard sources with two coincident gamma rays and the general features of the shape of the pulse height spectrum are discussed. Applications of this method in gamma scintillation spectroscopy are indicated, as for example the evaluation of the residual summing effect in the analysis of gamma scintillation spectra. (auth)

11884 A PRECISION CURRENT INTEGRATOR. C. H. Vincent and G. Sapsford (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 14: 160-72(Dec. 1961). (In English)

A precision current integrator is developed to measure the mean current from a fission chamber in a zero power reactor over each of a sequence of equal time intervals, and in this way to give an accurate determination of a long period, in spite of statistical fluctuations in the fission chamber current. This integrator is required to facilitate reactivity measurements on small samples of material in the experimental reactor VERA. The integrator and its associated electronic equipment are described. The latter includes a counterbalancing current source for backing off a large part of the fission chamber current and a crystal-controlled timer giving alternative integrating intervals of 50, 100, or 200 sec. The accuracy of the mean current measurements, relative to each other, is of the order of ±0.02%, which is comparable with the limit set by the inherent statistical error of the fission chamber current. (auth)

11885 SINGLE CHANNEL TRANSISTORIZED PULSE HEIGHT ANALYZER. A. Alberigi Quaranta and B. Righini (Università, Bologna). Nuclear Instr. & Methods, 14: 173-81(Dec. 1961). (In English)

A completely transistorized single-channel pulse analyzer is described, with a dead time of 330 nsec. The range on the pulses that may be analyzed is 0.3 to 6 v. The window width and the threshold voltage are independent and determined by the reverse bias of two distinct diodes. The complete circuit diagram is given with test results obtained with several input pulse widths up to a frequency of 2 Mc and for temperatures from 10 to 40°C. (auth)

11886 DESIGN AND USE OF A SELF-MONITORING COINCIDENCE ARRANGEMENT OF NANOSECOND RESOLUTION. S. C. Pancholi and N. K. Saha (Univ. of Delhi). Nuclear Instr. & Methods, 14: 189-92(Dec. 1961). (In English)

A self-monitoring coincidence arrangement of delayed coincidences is described. The resolving time of the coincidence system is ~2 nsec. The half lives for the 1.07-Mev first excited state of Sr^{86} and 1.52-Mev first excited state of Ca^{42} are determined to be <0.1 nsec and (1.0 ± 0.4) nsec respectively by this delayed coincidence method. (auth)

11887 ON TWO PULSE MODE AND IMPROVEMENT IN DEAD TIME OF DEKATRON DISPLAY ANALYSERS. P. K. Patwardhan (Atomic Energy Establishment, Trombay, India). Nuclear Instr. & Methods, 14: 200-4(Dec. 1961).

A "two pulse mode" is developed for adapting a GC10D (20-kc, single-pulse drive) Dekatron to have a self-gating capability, for use as a 100-channel display element. The modified Dekatron is used in a 100-channel analyzer. The basic design of this analyzer is discussed and it is shown that its dead time of 140 μsec compares favorably with that of analyzers using magnetic core storage. (auth)

11888 COINCIDENCE CIRCUIT OF TUNNEL DIODES. S. Gorodetzky, A. Muser, J. Zen, and R. Armbruster (Institut de Recherches Nucléaires, Strasbourgh). Nuclear Instr. & Methods, 14: 205-8(Dec. 1961). (In French)

A fast coincidence circuit with amplitude discriminator using tunnel diodes is described. A resolving time of 5 nanoseconds is obtained. The threshold of the circuit is adjustable from some tens millivolts to one volt. The operating range may be extended to 10 volts. (auth)

11889 EXPERIENCES ON THE APPLICATION OF THE SUM-COINCIDENCE METHOD. Gy. Máthé, D. Beréyni, and T. Scharbert (Institute of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Nuclear Instr. & Methods, 14: 209-14(Dec. 1961). (In English)

For the study of cascade γ-processes, the Hoogenboom sum-coincidence method makes possible the detection of transitions of very low intensity, and possesses advantages for measurements of angular correlation as well. In the sum-coincidence spectrum, false peaks or background levels of a certain height may appear in part of the discrimination region. This is partly due to instrumental reasons, partly to the characteristics of the method itself, and it depends on the properties of the decay scheme under study. (auth)

11890 EXPERIMENTAL STUDY OF THE INFLUENCE OF NON-PROPORTIONAL RESPONSE OF NaI(Tl) SCINTILLATION CRYSTALS UPON THE ENERGY RESOLUTION FOR GAMMA RAYS. P. Thieberger, E. C. O. Bonacalza, and H. Ryde (Nobel Inst. of Physics, Stockholm). Nuclear Instr. & Methods, 14: 225-30(Dec. 1961). (In English)

The resolution of a summing Compton spectrometer is accurately measured for several gamma ray energies. For the events detected, only one Compton scattering takes place in the first crystal. Thus for the part of the energy that is released in the first crystal, the contribution to the line width arising otherwise from a varying number of Compton electrons and non-proportional response of the scintillator is not present. This contribution is evaluated by comparing, for each energy, the resolution of the summing Compton spectrometer with the resolution expected if the total energy were shared by the two crystals in the same ratio, but multiple scattering were present in both of them. The results agree with theoretical expectations. (auth)

11891 A LARGE APERTURE DETECTOR FOR SLOW POSITIVE IONS. B. W. Ridley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 14: 231-6(Dec. 1961). (In English)

A detector is described in which slow positive ions are detected with uniform efficiency over an aperture 4 cm in diameter. The detector uses a single-stage box and grid type of electron multiplier, the secondary electrons from which are detected with a scintillation counter. The background counting rate above a pulse amplitude at which 99% of ion pulses are registered is 0.3 counts per sec. The energy dependence of counting efficiency is also investigated. (auth)

11892 PRACTICAL CONSEQUENCES OF THE INFLUENCE OF CHARGE RESISTANCE ON THE CORONA EFFECT IN SPARK DETECTORS OF THE WIRE-PLATE TYPE. P. Laborie and D. Blanc (Faculté des Sciences, Toulouse, France). Nuclear Instr. & Methods, 14: 237-8 (Dec. 1961). (In French)

The current-voltage relation for a corona discharge in a spark detector consisting of a flat cathode and a wire anode is studied, from the threshold voltage for the corona effect to about 5 kv. It is assumed that a resistance is placed in series with the anode. The treatment is extended to the case of several anodes. (T.F.H.)

11893 THE DEVELOPMENT OF A DILUTE ALUMINUM–GOLD ALLOY FOR THERMAL AND RESONANCE NEUTRON FLUX MEASUREMENTS. L. M. Howe, R. E. Jervis, and T. A. Eastwood (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Sci. and Eng., 12: 185-9(Feb. 1962).

Aluminum–gold alloy wire of very uniform cross section and composition was made for the preparation of neutron flux monitors. Because the wire is uniform, a device to cut it into pieces of equal length can be used for the rapid preparation of flux monitors and the need to weigh individual monitors can thus be avoided. Homogeneity of composition was achieved mainly by rolling and annealing, and the effectiveness of each step was assessed by neutron-activation analysis. The gold content of the final product (wire 0.018 in. diameter) was also determined by activation analysis and was found to be 0.0985 ± 0.0020 at.%. Thermal-neutron self-shielding in this wire is negligible and cadmium ratio experiments show that resonance-neutron self-shielding amounts to about 2.5%. (auth)

11894 COMPARISON OF SPECTRA OBTAINED FOR VARIOUS MEASUREMENT PARAMETERS IN A SINGLE-CHANNEL AUTOMATIC GAMMA-RAY SPECTROMETER. Jan Czubek, Tadeusz Florkowski, Ludwik Górski, and Andrzej Zuber (Inst. of Nuclear Research, Academy of Mining and Metallurgy, Krakow). Nukleonika, 6: 169-80 (1961). (In English)

A method of computing and using graphs for reducing the measuring time of low-level sources is described. The theoretical results are illustrated. Some properties of single channel pulse height analyzers are also discussed. (auth)

11895 HOMOGENEOUS CRYSTAL COUNTERS FOR NUCLEAR EMISSIONS. (A REVIEW). B. M. Golovin, B. P. Osipenko, and A. I. Sidorov. Pribory i Tekh. Ekspt., 6: No. 6, 5-13(Nov.-Dec. 1961). (In Russian)

Data are given on the construction, properties, and applications of crystal counters using various phosphors. (tr-auth)

11896 APPLICATIONS OF p–n JUNCTIONS FOR RECORDING NUCLEAR EMISSIONS. A. N. Pisarevskii, L. D. Soshin, and E. I. Firsov (Inst. of Physics, Academy of Sciences, Belorussian SSR). Pribory i Tekh. Ekspt., 6: No. 6, 14-20(Nov.-Dec. 1961). (In Russian)

The construction, performance and applications of p–n junctions in nuclear physics and other branches of sciences are described. (tr-auth)

11897 MAGNETIC BELT FOR MEASURING CYCLOTRON RELEASED ION BEAM. Yu. V. Korshunov and E. A. Meleshko (Inst. of Atomic Energy, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 6, 24-6(Nov.-Dec. 1961). (In Russian)

Descriptions are given of a ferrite-core magnetic belt designed for measuring the flux of an ion beam extracted from a cyclotron. The measurements are accomplished without beam overlap; this is useful when a target is not utilized as a current receiver. (tr-auth)

11898 DETERMINATION OF γ QUANTUM ENERGY IN XENON BUBBLE CHAMBER. L. P. Konovalova, L. S. Okhrimenko, and Z. S. Strugal'skii (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekh. Ekspt., 6: No. 6, 26-31(Nov.-Dec. 1961). (In Russian)

The energies of γ quanta in a xenon bubble chamber were measured at 10 to ~1000 Mev using a colorimetric method. The accuracy was ~20%. Theoretical data on electron-photon shower development were used for determining energies exceeding 1000 Mev. (tr-auth)

11899 CONSTANTS OF MULTIPLE SCATTERING IN MOLIÈRE FORMULATION CALCULATED FOR XENON BUBBLE CHAMBER. D. Pinter. Pribory i Tekh. Ekspt., 6: No. 6, 31-4(Nov.-Dec. 1961). (In Russian)

The Moliere method is used for determining the multiple scattering constant in order to measure charged particle pulses with constant cells. The magnitudes of K_r in relation to β are tabulated. (R.V.J.)

11900 FREON 570-LITER BUBBLE CHAMBER. A. S. Aleksanyan, A. I. Alikhanyan, M. M. Veremeev, A. M.

Gal'per, V. G. Kirillov-Ugryumov, L. P. Kotenko, L. A. Kuzin, E. P. Kuznetsov, and G. I. Merzon (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 6, 34-8 (Nov.-Dec. 1961). (In Russian)

The construction and operation of a 570-liter bubble chamber filled with freon-12 and freon-13 are described. The operating temperature of the mixture is 28°C. The gas pressure is 24 atm. The chamber responds to ionizing radiation 60 μsec following the discharge. The operational cycle is fulfilled within a few seconds. (tr-auth)

11901 PHOTOELECTRON MULTIPLIER CONTROLLED DIFFUSION CHAMBER. V. K. Lyapidevskii and M. M. Obodovskii (Moscow Inst. of Engineering Physics). Pribory i Tekh. Ekspt., 6: No. 6, 38-40 (Nov.-Dec. 1961). (In Russian)

Descriptions are given of a diffusion chamber with photomultiplier control. Pictures of α tracks and of the initial discharge in the chamber are included. The relationship between the magnitude of the liquid drop background and its fluctuation due to vapor flow and ion load was investigated. Variations in the vapor flow do not effect the saturation in the sensitive layer. (tr-auth)

11902 CHARACTERISTICS OF A SPARK COUNTER WITH PLANE-PARALLEL ELECTRODES. Yu. F. Skachkov. Pribory i Tekh. Ekspt., 6: No. 6, 41-4 (Nov.-Dec. 1961). (In Russian)

Characteristics of a plane-parallel spark counter with short discharge interval and filled with mixtures of He + O_2, Ne + O_2, Ar + O_2, and Xe + O_2 are described. The resolving times of counters filled with He + O_2 and Ne + O_2 are 10^{-11} and 3×10^{-11} sec. (tr-auth)

11903 SILICON DETECTOR OF HEAVY CHARGED PARTICLES. V. V. Bredel, V. L. Mikheev, and S. M. Polikanov (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekh. Ekspt., 6: No. 6, 44-8 (Nov.-Dec. 1961). (In Russian)

A method is suggested for preparing charged particle detectors from n-silicon. The spectra of fission fragments and α particles obtained with such detectors are included. The detector behavior at various temperatures and in magnetic field is analyzed. (tr-auth)

11904 GAS DISCHARGE CHAMBER. A. M. Govorov, V. I. Nikanorov, G. Peter, A. F. Pisarev, and Kh. Poze (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekh. Ekspt., 6: No. 6, 49-51 (Nov.-Dec. 1961). (In Russian)

The performance characteristics are given for a discharge chamber with 25 × 10 cm electrodes and a 70-mm electrode clearance. The chamber is filled with neon (argon admixture of 0.3 to 0.45%) under 760 mm pressure. Pictures of cosmic particles and proton tracks are shown, and the counter efficiency curves are plotted. (R.V.J.)

11905 MEASUREMENTS OF CHARGED PARTICLE MASS BY MEANS OF SCINTILLATION COUNTERS. A. V. Khrimyan, K. Sh. Egiyan, N. A. Nalbandyan, V. V. Avakyan, and V. A. Karapetyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Pribory i Tekh. Ekspt., 6: No. 6, 52-6 (Nov.-Dec. 1961). (In Russian)

It is shown that charged particle mass can be determined with a group of scintillation counters capable of selecting ionization induced particle delays in the scintillators. The mass is determined from the particle energy and track. The mean accuracy of the method is about 20%. (R.V.J.)

11906 MULTI-CHANNEL AMPLITUDE ANALYZER FOR SIMULTANEOUS MEASUREMENTS OF SPECTRA. R. G. Ofengenden and L. D. Konenko (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Pribory i Tekh. Ekspt., 6: No. 6, 65-9 (Nov.-Dec. 1961). (In Russian)

Descriptions are given of a pulse analyzer with a magnetic drum memory device for measuring several amplitude spectra. (R.V.J.)

11907 MULTI-CHANNEL NANOSECOND TIME ANALYZER. A. A. Kurashov and V. A. Sidorov (Inst. of Atomic Energy, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 6, 69-73 (Nov.-Dec. 1961). (In Russian)

The design of a fast neutron time-of-flight spectrometer with a 3 nsec resolving time is presented. The channel width is ~1 nsec, with width irregularity of about 0.1%. The recording system of the analyzer consists of 256 channels with a capacity of 2^{16} pulses. The data are automatically recorded. (R.V.J.)

11908 TIME SELECTOR FOR SERIES PULSE ANALYSIS. V. G. Brovchenko and Yu. D. Molchanov (Inst. of Nuclear Energy, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 6, 74-7 (Nov.-Dec. 1961). (In Russian)

The selector is used for measuring pulse time in a series of pulses. The minimum channel width is 25 μsec; the clearance between channels is 2.5 μsec. Due to the small resolving time ($\sim 3 \times 10^{-8}$ sec) the instrument can be used for recording single and rarely repeating processes. The signal curve, which is similar to the pulse distribution, is produced by periodically discharging a condenser storage device. Photographs may be obtained from an oscillograph tube. (R.V.J.)

11909 HIGH-SPEED PULSED OSCILLOGRAPH. L. S. Bartenev, G. V. Glebovich and K. N. Ptitsin (Inst. of Scientific Research in Radiophysics, USSR). Pribory i Tekh. Ekspt., 6: No. 6, 80-3 (Nov.-Dec. 1961). (In Russian)

An oscillograph with a maximum scanning rate of 2×10^{10} cm/sec, maximum instability of 1.5×10^{-11} sec, and capable of recording processes of 10^{-10} sec is described. (tr-auth)

11910 DEVICE FOR CALIBRATING CHANNEL SENSITIVITY FOR ION CURRENT IN DOUBLE FOCUSING MASS SPECTROMETER. I. V. Gol'denfel'd and I. Z. Korostyshevskii (Inst. of Physical Chemistry, Academy of Sciences, Ukrainian SSR). Pribory i Tekh. Ekspt., 6: No. 6, 83-5 (Nov.-Dec. 1961). (In Russian)

A device and method are suggested for calibrating the channel sensitivity of a double-focusing mass spectrometer without using isotopic analysis. The accuracy of the calibration is about ±0.02%. The method can be applied for determining absolute values of high ohmic resistances and for checking the linearity. (tr-auth)

11911 MULTIPLY CHARGED PULSED ION SOURCE WITH MAGNETIC SEPARATION. L. I. Bolotin, P. S. Markin, and S. I. Meleshkov. Pribory i Tekh. Ekspt., 6: No. 6, 86-8 (Nov.-Dec. 1961). (In Russian)

A multicharged ion source with prolate pulses and magnetic beam separation is described. Beams of N^{4+} (1.4 ma), N^{3+} (1.5 ma), and N^{2+} (2 ma) are accelerated to 400 kev and focused on a 15-mm spot. (tr-auth)

11912 SPARK SOURCE OF MULTICHARGED IONS. L. I. Bolotin, P. S. Markin, Yu. F. Kulygin, G. M. Skoromnyi, and S. I. Meleshkov. Pribory i Tekh. Ekspt., 6: No. 6, 88-90 (Nov.-Dec. 1961). (In Russian)

Pulsed currents of N^{4+} and C^{4+} ions of 100 μa (15 μsec pulses) and N^{3+} ions of 300 μa and C^{3+} of 500 μa (500 μsec pulses) may be achieved. The intensity of the total ion current is 15 ma. (tr-auth)

11913 NEW PHOTOELECTRON MULTIPLIERS. G. S. Vil'dgrube, N. V. Dunaevskaya, and I. A. Kharitonova. Pribory i Tekh. Ekspt., 6: No. 6, 91-3(Nov.-Dec. 1961). (In Russian)

The construction of photomultiplier FEU-53 with antimony-cesium cathode on a chromium layer and FEU-52 with antimony-potassium-sodium-cesium cathode is described. Their parameters, characteristics, and operational data are discussed. (tr-auth)

11914 APPLICATION OF PLUTONIUM α PREPARATION IN IONIZATION CALORIMETER. K. A. Kotel'nikov, O. F. Ogurtsov, and N. E. Khromykh (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 6, 126-7(Nov.-Dec. 1961). (In Russian)

An ionization calorimeter using an open Pu^{239} α preparation is described. Such a calorimeter eliminates interference from fission products and is free of radioaerosols. The scheme of the device is included. (R.V.J.)

11915 POSSIBLE ENERGY SOURCES OF ION OSCILLATIONS IN HIGH OR ULTRAHIGH VACUUM. Nikolai Eberhardt (Siemens & Halske A. G., Munich). Z. angew. Phys., 13: 560-5(Dec. 1961). (In German)

Ion plasma oscillations have been reported in various amplifiers (moving field tubes, klystrons, and endtetrodes) for some time. Two new mechanisms for the initiation of these oscillations are discussed. The first depends on a phase separation of the particles which oscillate at a top potential with non-linear power laws and are mutually repelled. There is a similarity with the mechanism of Barkhaus oscillations. The second possibility is given when ions are ionized to a higher degree in a stepwise manner. In the course of plasma oscillations, more ionizing collisons occur at the site of higher instantaneous ion density than at the site of lower density. Therefore a degassing occurs. (tr-auth)

11916 ABSOLUTE BLACKENING CURVES OF MASS SPECTROGRAPHIC PHOTOMATERIALS FOR POSITIVE IONS. W. Rudolff (Freie Universität, Berlin). Z. Naturforsch., 16a: 1263-4(Nov. 1961). (In German)

Absolute blackening curves for ions of constant energy (9 kev) were measured for five gelatin-poor, commercial emulsions (Ilford Q1, Q2, and Q3 plates, Eastman Kodak SWR-film, and the Agfa(Wolfen)-Schumann plates). The ion masses were in the range from 2 to 40. The experimental conditions are given, and some of the curves obtained are shown as examples. The mass dependence of the sensitivity was measured for the Ilford Q1 plates. (J.S.R.)

11917 INVESTIGATIONS ON A GAS SCINTILLATION COUNTER. W. Lorenz and K. H. Lauterjung (Max-Planck-Institut für Kernphysik, Heidelberg and Universität, Cologne). Z. Physik, 165: 74-8(1961). (In German)

The dependence of the light yield and the energy resolution on the filling gas pressure was investigated in a gas scintillation counter with argon as the filling gas and with anthracene, sodium silicilate, tetraphenyl, and diphenyl stilbene as long wave damper. With diphenyl stilbene as the long wave damper, the light yield and energy resolution was compared with argon and xenon as the filling gas as a function of the pressure. (tr-auth)

11918 UNIVERSAL NUCLEAR MAGNETIC RESONANCE SPECTROMETER. V. A. Afanas'ev, V. F. Bystrov, and L. L. Dekabrun, Yu. N. Kil'yanov, and A. U. Stepanyants (Inst. of Chemical Physics, Academy of Sciences, USSR). Zavodskaya Lab., 28: 102-3(1962). (In Russian)

The design of a universal nuclear magnetic resonance spectrometer is given. The spectrometer is capable of recording the spectra of liquids with a resolving power up to 10^{-7} 30-gauss signals from solid bodies, and relaxation times T_2 (along the width) of 10^{-5} to 10^{-2} sec, T_1 (by inversion) from 10^{-2} sec, and T_1 (by saturation) at 10^{-4} sec and up. The spectrometer sensitivity is 10^{20} nuclei/cm^3 with a working volume of 50 mm^3. (R.V.J.)

11919 ELECTROSTATIC FOCUSING OF INTENSIVE BEAMS OF CHARGED PARTICLES IN SYSTEMS WITH CYLINDRICAL CATHODE. V. P. Ignatenko. Zhur. Tekh. Fiz., 31: 1443-50(Dec. 1961). (In Russian)

The focusing of high density charged particle beams from a cylindrical cathode is analyzed. The conditions are found under which a beam converges after leaving the openings in an anode system. The minimum beam cross sections are determined, and it is shown that in the examined system the particle thermal velocities can alter the focusing only at very low anode potentials. (R.V.J.)

11920 MODELING DEVICE WITH VIBRATING CHARGED PROBE FOR MEASURING TWO-DIMENSIONAL FIELDS. G. M. Gershtein and G. K. Fedonin (Saratov State Univ., USSR). Zhur. Tekh. Fiz., 32: 112-18(Jan. 1962). (In Russian)

A device with a vibrating charged probe was developed for modeling two-dimensional fields described by Laplace equations. The device was used for measuring cylindrical and quadrupole condenser fields and sectional structures. The results were sufficiently accurate for most laboratory experiments. However, it was found that the accuracy can be improved by compensation methods in a-c measurements and by developing probes with more stable charge. (R.V.J.)

11921 IMPROVEMENTS IN OR RELATING TO SPECTROGRAPHS. Alan Henry Gabriel (to United Kingdom Atomic Energy Authority). British Patent 890,659. Mar. 7, 1962.

A time-resolved spectrograph is designed for recording spectra as they vary with time, in the region 500 to 2500 A. The spectrograph comprises a vacuum chamber, a concave grating within the chamber, a vertical slit aperture lying on a circle within the chamber, a horizontal slit aperture in the chamber wall and lying on a tangent to a point on the circle diametrically opposite the grating, a mirror rotatably mounted in the path of radiation diffracted by the grating with the rotation axis parallel to the direction of wavelength dispersion, and a holder for photographic plates. The mirror is driven at speeds up to 60,000 rpm, and the writing speed can be 3 mm/μsec. (D.L.C.)

11922 IMPROVEMENTS IN OR RELATING TO RADIATION METERS. Sydney Norman Pocock (to Mullard Ltd.). British Patent 890,741. Mar. 7, 1962.

An ionization chamber type radiation meter using the control grid of an amplifier tube to give a logarithmic indication of the radiation intensity is designed for accurate and rapid zeroing. The meter comprises an ionization chamber having two anodes and a collector electrode arranged between the anodes to divide the chamber into two equal volumes. When the second anode is connected to a source of negative saturation bias potential, the ion currents from ambient or external radiation cancel each other out, and the actual collector current is due entirely to the ionization caused by the calibration radiation source in the volume bounded between the first anode and the collector electrode. (D.L.C.)

11923 IMPROVEMENTS IN OR RELATING TO ELECTRICAL CONDITION-DETECTING APPARATUS, SUCH AS FOR USE IN FLAME-DETECTION. (to Minneapolis-Honeywell Regulator Co.). British Patent 890,854. Mar. 7, 1962.

A flame and/or smoke detecting apparatus using a Geiger-Mueller sensing device is designed which may operate in the standby condition for a long time and which prevents false indication of fire in the event of power interruption. The Geiger-Mueller device is of the non-self-quenching type, and a quenching circuit is provided with time delay means to maintain the Geiger-Mueller device insensitive until the circuit is fully operative, such as after a power failure. Fire is indicated when the device responds to u-v light either emitted by the flame or reflected from an auxiliary source by the smoke. (D.L.C.)

11924 IMPROVEMENTS IN OR RELATING TO TRANSISTOR D.C. AMPLIFIERS. Edmund Harry Cooke-Yarborough (to United Kingdom Atomic Energy Authority). British Patent 891,424. Mar. 14, 1962.

A pulsed d-c transistor current amplifying stage is designed for low drift. The stage comprises a junction transistor, an input current connection to the base thereof, a pulsed voltage source, and a capacitor connected between the pulsed source and the base. The capacitor is charged during each pulse through the emitter/base junction and discharged between pulses through the input current connection, the time constants being long compared with the pulse duration and rest period. The stage has the following advantages over a transistor chopper d-c amplifier: a demodulator is not required; errors are not introduced by spurious a-c signals; and the frequency response is greater. (D.L.C.)

Materials Testing

11925 (ARF-6043-23) ULTRASONIC METHODS FOR NON-DESTRUCTIVE EVALUATION OF CERAMIC COATINGS. Sixth Quarterly Progress Report, October 1, to December 31, 1961. K. E. Feith and W. E. Lawrie (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 15, 1962. Contract AF 33(616)-6396. 26p.

Activities in a program to determine the strength and integrity of ceramic coating—metal bonds are described. Flame-sprayed ceramic and diffusion coatings are being examined ultrasonically. Design of equipment to investigate compressional wave propagation and surface wave attenuation in these coatings is reported. Development and adaptation of the Schlieren optical system for examination of the propagation and interaction of compressional waves with solids in transparent media is also reported. Flame-spraying techniques were improved so that less porous and more uniform flame-sprayed coatings are available. Thin films of zirconium oxide were also produced which are suitable for ultrasonic tests. Further work was also done using surface wave techniques to determine ultrasonic attenuation in homogeneous materials, and coatings. (J.R.D.)

11926 (GA-2669) DEVELOPMENT OF ULTRASONIC INSPECTION FOR GRAPHITE MATERIAL. P. T. Mattson, Jr. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 24, 1962. Contract AT(04-3)-314. 24p.

Development of ultrasonic inspection methods for heavy-wall graphite sleeves is described. Results indicate that certain structural defects in graphite tubing can be consistently detected. Only through-transmission was found to be suitable in all cases and a total loss of signal on the receiver must occur before a defect can be positively identified. It was concluded that production-type flaw inspection can be accurately carried out on such tubing by semiautomatic rapid scanning. (J.R.D.)

11927 (HW-70638) ULTRASONIC TESTING OF HEAVY-WALLED ZIRCALOY TUBING. R. C. Aungst (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 4, 1961. Contract AT(45-1)-1350. 43p.

An ultrasonic testing technique was developed for revealing surface and sub-surface defects lying transverse to the axis of Zircaloy tubing $3\frac{1}{4}$ inch in diameter with $\frac{1}{4}$-inch wall. The accurate production and measurement of standard scratches or notches for calibration of the ultrasonic equipment were performed by specialized processes. The test proved reproducible on three different sets of ultrasonic inspection equipment. Discrimination was demonstrated between artificially produced defects $\frac{1}{8}$-inch long by 1 mil and 3 mils in depth. The method reliably detected known defects of similar size introduced in the tubing at various steps in the fabricating process. (auth)

11928 (SCR-308) OPTICAL INSPECTION DEVICE USING FIBER OPTICS. Final Report, April 1961—August 1961. (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 1962. For Sandia Corp., Albuquerque, N. Mex. Contract [AT(29-1)-789]. 30p.

Activities in a program for development of a highly flexible inspection probe having an insertion length of 36 in. and an outer diameter of less than 0.380 in. are described. The purpose of the inspection device is to view a remote cavity containing one or more wires. The design of a probe is described which has four small compact light sources, opaque covers over individual coated fibers, and a fiber optics illumination plate at the distal end. The outside diameter is 0.380 in. thus permitting the use of more illumination and imaging fibers. The field of view illumination is 22 foot candles, giving good image contrast and allowing objects 1.5 in. from the probe to be viewed at a resolution of 15 lines per in. Therefore, the image of a $\frac{1}{16}$ in. diameter wire is equivalent to two fiber diameters. It is felt that this probe fulfills the design specifications and demonstrates the feasibility of constructing a highly flexible fiber optics probe utilizing co-axial illumination. (auth)

11929 (WADD-TR-60-190) ELECTRON BEAM TECHNIQUE FOR MEASURING THE THERMOPHYSICAL PROPERTIES OF MATERIALS. H. M. Childers and J. M. Cerceo (American Machine and Foundry Co., Alexandria, Va.). July 1961. Contract AF33(616)-6527. 66p.

The determination of the suitability of electron bombardment for measuring the thermophysical properties of materials is made. A theory is developed which is applicable to the case of a radiating cylindrical sample. Conclusions are that the technique offers a valuable tool for measuring these properties within described limits. Values of α, k, and ρc_p, were determined for graphite and Al_2O_3 (Polycrystalline) and found to be accurate within the limitations inherent in the equipment used. Recommendations on instrumentation are made for the further development of this technique. (auth)

11930 (WAL-TR-142/67) THE FEASIBILITY OF USING NEUTRON RADIOGRAPHY AS A NONDESTRUCTIVE TESTING TECHNIQUE. Arnold W. Schultz and William Z. Leavitt (Watertown Arsenal Labs., Mass.). Dec. 1961. 16p.

A preliminary study was conducted to determine the feasibility of using neutron radiography for examining ordnance materials. Depleted U and 4140 steel castings in various thicknesses were examined. In addition, a thin section of Be, a grasshopper and a cricket were radiographed to illustrate the ability of neutrons to determine defects in

low-density materials. For uranium thicknesses up to 5 in., a contrast sensitivity between 1.5 and 7.5% was obtained using thermal neutrons, In foil, and industrial x-ray film transfer techniques. For 6 in. of U, a contrast sensitivity between 6.3 and 12.5% was obtained. For U thicknesses up to 6 in., a detail sensitivity of 2.1% was obtained. For thicknesses up to 4 in. of steel, a contrast sensitivity between 1.9 and 9.4% and a detail sensitivity between 0.8 and 3.1% were obtained. For 5.125 and 6 in. of steel, contrast sensitivities between 14.6 and 29.2% and 14.6 and 39.6%, respectively, and detail sensitivities of no less than 4.9% were obtained. Both a contrast and a detail sensitivity of about 5% were obtained in examining a thin section of Be. Recommendations for further studies are given. (auth)

11931 RADIOGRAPHY OF BERYLLIUM. H. R. Splettstosser (Eastman Kodak Co., Rochester, N. Y.). Nondestructive Testing, 20: 98-102(Mar.-Apr. 1962).

Radiographic technique studies were made on samples of beryllium from 0.06 inch to 6 inches thick. Judicious adjustment of technique factors gave radiographic sensitivity equivalent to that commonly reported for other light metals such as magnesium and aluminum. The use of soft radiation and proper focus-film distances are most important. Because of the ease with which thick specimens can be penetrated, and the quality and quantity of scattered radiation involved, scattering becomes a problem when specimens of large volume are radiographed. A Potter-Bucky diaphragm significantly improves radiographic sensitivity on large volume specimens over three inches thick, using practical exposure conditions. (auth)

11932 AN INSTRUMENT FOR NONDESTRUCTIVELY TESTING FUEL CORE TO CLADDING HEAT TRANSFER. Donald R. Green (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng., 12: 271-5(Feb. 1962). (HW-SA-2232)

An instrument for nondestructively mapping core to cladding heat transfer quality in fuel elements was developed. Heat transfer defects down to $\frac{1}{8}$ in. diameter in Zircaloy-2 clad and down to $\frac{3}{8}$ in. diameter in X-8001 aluminum alloy clad uranium fuel elements were detected. An infrared radiometer was used to detect fuel element surface temperature variations during induction or plasma arc jet heating. The unusual application of plasma arc heating in this instrument made heat transfer testing of nonuniform fuel elements feasible. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

Refer also to abstract 11972

11933 (CEX-58.4.2) AERORADIOACTIVITY SURVEY AND AREAL GEOLOGY OF THE SAVANNAH RIVER PLANT AREA, SOUTH CAROLINA AND GEORGIA. Robert G. Schmidt (Geological Survey, Washington, D. C. and Division of Biology and Medicine, AEC). Dec. 1960. 41p.

A survey of 10,000 square miles near Augusta, Ga., was made by the U. S. Geological Survey for the U. S. Atomic Energy Commission. Continuous radioactivity profiles were obtained with scintillation-counting equipment at approximately 500 ft above the ground on parallel northwest-southeast flight lines spaced 1 mile apart. A map of aeroradioactivity units was prepared from the profiles. The gamma-radiation data indicates a wide range in the levels of natural radioactivity and that the levels are closely related to the types of underlying rock. About 2000 square miles of the Piedmont province, partly mantled by thick residual soil, are included in the area. Three types of bedrock are present: a metamorphic complex of schist, gneiss, and granite; argillite, slate, and schist of the Carolina slate belt (Little River series of Crickmay); and plutons of granite and porphyritic granite. The granites and parts of the metamorphic complex have a high aeroradioactivity; the aeroradioactivity of the slate belt is generally low. Several rock units in the Piedmont, irrespective of weathering, may be mapped by their characteristic radioactivity. The Coastal Plain, consisting of several sedimentary units which range in age from Cretaceous to Quaternary, comprises the rest of the area surveyed. These rocks consist of soft sand, silt, clay, gravel, marl, and limestone. The aeroradioactivity of the Upper Cretaceous and Eocene rocks ranges from moderate to high whereas that of the younger beds is generally low. (auth)

11934 (NP-11580) ON THE RADIOACTIVITY OF PLANTS FROM THE HIGH RADIATION AREAS OF THE KERALA COAST AND ADJOINING REGIONS. I. STUDIES ON THE UPTAKE OF GAMMA-EMITTING RADIONUCLIDES. A. R. Gopal-Ayengar and K. B. Mistry (India. Atomic Energy Establishment, Trombay). [1962]. 20p. (SM-23/12)

For presentation at Symposium on the Use of Radioisotopes in Soil-Plant Nutrition Studies, February 26–March 2, 1962, Bombay.

Deposits of radioactive minerals occur in formations along the Kerala coast in southern India. The radioactive component of these deposits is monazite which contains principally Th, together with several rare-earth minerals, rutile, sillimanite, zircon, and titanium-bearing ilmenite. The Th content of the monazite ranges from 8.0 to 10.5% in some areas. Results are reported from studies on the uptake of radioelements of the Th series by 14 species of plants native to the region. Data on concentrations of Th^{228}, Ra^{224}, Ac^{228}, Bi^{212}, and Tl^{208} in samples of plant materials, and the complete γ spectra for 24 samples, are tabulated. Ra^{224} content was higher than that of the other nuclides in all plant species. Data suggest the possibility of accumulation mechanisms for some of the plant species. (C.H.)

11935 (RME-4524(Rev.)) RECONNAISSANCE FOR URANIUM IN THE MAMIÑA AREA, PROVINCE OF TARAPACA, CHILE. Paul H. Knowles, William A. Bowes, Mario Serrano C., and Erik Klohm H. (Division of Raw Materials, AEC and Chile. Instituto de Investigaciones Geologicas, Santiago). Oct. 1958. 15p.

In 1958 geologists of the U. S. Atomic Energy Commission and the Instituto de Investigaciones Geológicas de Chile made a reconnaissance for uranium in the Mamiña area, Province of Tarapacá in northern Chile. No significant radioactivity was measured during this preliminary reconnaissance; therefore, it is believed that the Mamiña area probably has only slight uranium potential and warrants little additional investigation. (auth)

11936 (TEI-806) INTERIM GEOLOGICAL INVESTIGATIONS IN THE U12e.03a AND U12e.03b TUNNELS, NEVADA TEST SITE, NYE COUNTY, NEVADA. W. L. Emerick and D. D. Dickey (Geological Survey, Washington, D. C.). Mar. 1962. Includes section on GAMMA RADIOACTIVITY SURVEY OF U12e.03a TUNNEL. C. M. Bunker. 49p.

The U12e.03a and U12e.03b tunnels are a part of the U12e tunnel system, which has been driven southwestward beneath Rainier Mesa in the northern part of the Nevada Test Site. The tunnels were driven in nonwelded tuff of Tunnel Beds 4 and 3 near the top of the lower member of the Oak Spring Formation of Miocene or younger Tertiary age. At distances of 705 to 755 feet below the tunnels the hard resistant dolomite of Paleozoic age underlies the tuffs of the Oak Spring Formation. The vertical distance to the surface of Rainier Mesa is 1,318 feet above the end of the U12e.03a tunnel and 1,360 feet above the end of the U12e.03b tunnel. The tuffs in the U12e.03a tunnel strike N. 89° E. and dip 3° S.; they strike N. 86° W, and dip 9° S. in the U12e.03b tunnel. The relatively simple structure in the U12e.03a tunnel is modified slightly by three normal faults of small displacement; the structure of the U12e.03b tunnel is uncomplicated by faults or folds. Joints are common in both tunnels with about 70 percent of them northwest trending and the remainder northeast trending. Dips of the joints are vertical or dip steeply to either the southeast, northeast, or southwest. The tuffs exposed in the U12e.03a and U12e.03b tunnels are similar chemically and physically to the tuffs studied elsewhere in the U12e tunnel. Results of a gamma-radioactivity survey indicate that this type of survey cannot be used to aid stratigraphic discrimination. It does indicate that the radioactivity of the tuffs is low enough not to interfere with studies of gamma-emitting radioisotope distribution resulting from underground explosions of nuclear devices. Zones of anomalous radioactivity appear to be related to fracturing or faulting. (auth)

11937 (TID-15116) THERMOLUMINESCENCE AND THE GEOCHEMISTRY OF CALCIUM CARBONATE IN RELATION TO RADIOACTIVE IMPURITY CONTENT. Technical Progress Report, April 1, 1961 to March 1, 1962. (Kansas. Univ., Lawrence). Contract AT(11-1)-1057. 46p.

Continued research is reported in carbonate geochemistry and thermoluminescence. Significant results obtained in excitation of thermoluminescence by radiation in the visible and near ultraviolet regions are discussed. Studies of carbonate geochemistry resulted in advances concerning the effects of Sr, Mg, and Sr/Ca ratios on recent carbonate sediments. Continued development of a means to use thermoluminescence for dating geologic events based on natural alpha activity is reported. Good results were obtained in a K/Ar date check on the material under study. (J.R.D.)

11938 (UCRL-13032) SOURCES OF INFORMATION ON ROCK PHYSICS. Current Literature, January 31, 1962. Lorraine Burgin (Colorado School of Mines Research

Foundation, Inc., Golden). Jan. 31, 1962. For California. Univ., Livermore. Lawrence Radiation Lab. Contract [W-7405-Eng-48]. 85p.

A review which pertains to the fields of rock physics and mechanics, wave propagation and related subjects is presented. Author's abstracts or introductions are in quotation marks and, where time permitted, the sections treated in the main articles are also noted. (About 200 references). (J.R.D.)

11939 (AEC-tr-4529) SEARCH FOR URANIUM DEPOSITS. V. G. Melkov and L. Ch. Pukhal'skii. Translation of "Poiski Mestorozhdenii Urana" (a Publication of the State Scientific Technical Publishing House for Literature on Geology and the Preservation of Mineral Resources, Moscow, 1957). 353p.

A book on the geological basis and methods of searching for U deposits is presented. Information is included on methods of conducting geological surveys, prospecting for deposits of various other minerals, and efficient geological mining. (J.R.D.)

11940 (CEA-tr-A-1041) ETUDE DES RAYONNEMENTS AMBIANTS PENETRANTS D'ORIGINE EXTERIEURE. (Investigation of the Penetrating External Background Radiation). W. Herbst and G. Huebner. Translated into French by R. Carbonnier from Atomkernenergie, 6: 75-81(1961). 41p. (Includes original, 7p.).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 14581.

11941 THE DEPOSITION OF STRONTIUM-90 ON THE GROUND. W. Haeussermann and W. Morgenstern (Landwirtschaftliche Hochschule, Stuttgart-Hohenheim). Atompraxis, 8: 37-40(Feb. 1962). (In German)

The variations of fall-out activity and of Sr^{90} concentrations in ground-level air and in rainwater at Stuttgart-Hohenheim since 1958 are reported. The dependence of the Sr^{90} concentrations of soil samples from different places in Baden-Württemberg on the vegetation and on the amount of precipitation was examined, and the counting and analyzing methods are described. (auth)

11942 MEASUREMENT OF ARTIFICIAL RADIOACTIVITY IN THE SOUTHERN HEMISPHERE. B. Ardouin (Centre d'Etudes Nucleaires, Saclay, France), C. Jehanno, J. Labeyrie, G. Lambert, B. Parlier, and R. Jouanne. Bull. inform. sci. et tech. (Paris), No. 56, 2-13(Nov. 1961). (In French)

At the end of 1959, during the 10th French Antartic expedition, apparatus for the collection and radioactivity measurement of aerosols and precipitates were installed at the Kerguelen Islands and in Terre Adélie. In addition the Norsel, in charge of transporting the expedition, was equipped with an aerosols collection unit. The results from the first year of operation are presented. They confirm the low contamination rate of the Southern Hemisphere in artificial radioactive nuclides, and lead to the supposition that an equatorial barrier exists between the atmospheres of the two hemispheres, North and South. (auth)

11943 THE ABSOLUTE ISOTOPIC ABUNDANCE RATIO AND THE ATOMIC WEIGHT OF NATURAL SILVER. E. A. C. Crouch and A. H. Turnbull (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Chem. Soc., 161-70(Jan. 1962).

An examination of the isotopic abundance ratio in natural silver by means of the mass spectrometer resulted in a value of 1.0733 ± 0.0043 for the absolute isotopic abundance ratio Ag^{107}/Ag^{109}. Specimens of commercial silver of diverse ages possess abundance ratios within the limits of the determinations and thus the calculated atomic weights are: chemical scale (O = 16) 107.8740 ± 0.0033; physical scale (O^{16} = 16) 107.9037 ± 0.0026; unified scale (C^{12} = 12) 107.8694 ± 0.0026. The uncertainties indicated with these figures are the 95% confidence limits for the random errors added to estimates of possible systematic errors. These results are in very close agreement with recent work and differ significantly from the present internationally accepted values. It was shown that the mass discrimination in the mass spectrometers used is dependent on the magnitude of the isotopic ratio. When an electron multiplier is used the correction due to the differing isotopic masses of the ions accelerated to the same energy (approximately 8 kv) is directly proportional to the ratio of the square root of the masses with an accuracy of 4 parts in 10000. (auth)

11944 SOME STUDIES OF THE P WAVES FROM UNDERGROUND NUCLEAR EXPLOSIONS. J. K. Wright, E. W. Carpenter, and R. A. Savill (Atomic Weapons Research Establishment, Essex, Eng.). J. Geophys. Research, 67: 1155-60(Mar. 1962).

First arrivals (P_n) from the Hardtack series of underground explosions, at up to 1000 km, are analyzed. There is no measurable dispersion in these arrivals, and the possibility that the observed decay of amplitude with distance is due to a low-velocity layer below the Mohorovicic discontinuity is discussed. (auth)

11945 DETERMINATION OF CONCENTRATION OF CAESIUM-137 IN PRECIPITATION AND GROUND-LEVEL AIR IN SWEDEN. G. Lindblom (Research Inst. of National Defence, Stockholm). Nature, 193: 866-7(Mar. 3, 1962).

Graphs are presented for the Cs^{137} activity of precipitation collected at Gothenburg and Kiruna in 1958 to 1960 and of ground-level air collected at Stockholm and Edsvalla in 1958 to 1961. (D.L.C.)

11946 GEOLOGY OF THE ATOMIC ENERGY COMMISSION, NEVADA PROVING GROUNDS AREA, NEVADA. Mike S. Johnson and Donald E. Hibbard (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1021-K. 1957. 85p., 2 illus. $1.00(GPO).

HEALTH AND SAFETY

Refer also to abstract 12698

11947 (AEET/HP/SM-2) HAZARDS IN HANDLING PLUTONIUM. K. C. Pillai, S. Somasundaram, and P. R. Kamath (India. Atomic Energy Establishment, Trombay). July 1, 1958. 19p.

The nuclear and metabolic properties of Pu^{239} are described briefly. Maximum permissible levels of Pu^{239} in the body (personnel), air, water, surfaces, and soil are given. Design of laboratory facilities for handling plutonium is discussed. Safe handling rules are given. (D.L.C.)

11948 (AFCRL-468) AREA-DOSAGE RELATIONSHIPS AND TIME OF TRACER ARRIVAL IN THE GREEN GLOW PROGRAM. Air Force Surveys in Geophysics No. 134 William P. Elliott, R. J. Engelmann, and Paul W. Nickola (Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.). May 1961. 38p. (AD-261584)

An empirical relationship between the area in which a given dosage is equalled or exceeded and the value of the dosage itself are developed using Green Glow data. It is found that the logarithm of the area is nearly a linear function of the logarithm of the dosage divided by the source strength and multiplied by a representative wind speed. These results differ only slightly from similar results obtained from Prairie Grass data. Observations of the time of first arrival of the tracer near ground level at distances of 8 and 16 miles from the source indicate that the tracer material which first arrives has travelled with a wind speed greater than the surface wind (about 15 ft). It would be necessary to have wind speed measurements between 50 and 100 ft above ground in order to estimate the time of first arrival at these distances even though the source is no higher than 15 ft. (auth)

11949 (APAE-79(Suppl.2)) HAZARDS REPORT FOR SM-1 CORE TEMPERATURE AND FLOW INSTRUMENTATION (TASK XIV) COVERING SPECIAL TEST PROCEDURES. P. L. Bradley and J. R. Coombe (Alco Products, Inc., Schenectady, N. Y.). Feb. 28, 1962. Contract AT(30-1)-2639. 81p.

Test procedures for special tests involving in-core SM-1 temperature and flow instrumentation are described (Task XIV Package Tests). These tests involve in-core steady state flow and temperature measurements, loss of flow transients, load transients, reduced primary system pressure operation and reduced element flow. The thermal and hydraulic conditions prevailing in these tests, including steady state and transient burnout ratios, were developed. The effects of reduced system pressure and flow on the burnout ratios were determined as were the expected stuck rod conditions when Task XIV test elements are installed. The effect on the maximum credible accident is included and a recommendation to conduct these Task XIV package tests is made. (auth)

11950 (HW-69168) PLUTONIUM RECYCLE CRITICAL FACILITY, FINAL SAFEGUARDS ANALYSIS. J. K. Anderson and W. K. Winegardner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1962. Contract AT(45-1)-1350. 113p.

The Plutonium Recycle Critical Facility (PRCF) is a very low-power experimental reactor and is designed to supplement the Plutonium Recycle Test Reactor (PRTR). The Critical Facility will be used for the determination of basic nuclear constants of heterogeneous reactors recycling plutonium, to assist in planning PRTR fuel loadings, to obtain reactivity measurements of reactor fuels, and for exponential, approach-to-critical, and critical experiments. A description of the reactor, building, and associated equipment is presented. A description of the anticipated operating program and operating procedures is also included. Reactor safeguards aspects of possible equipment malfunction and procedural errors are analyzed and inherent reactor safety features are described. (auth)

11951 (HW-72107) THE UPTAKE OF STRONTIUM FROM DIET AND WATER BY RAINBOW TROUT. R. H. Schiffman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1961. Contract AT(45-1)-1350. 11p.

The concentration ($\mu c/g$) of $Sr^{90}-Y^{90}$ in trout approached about 1.5 times the concentration ($\mu c/ml$) in the surrounding water in three weeks. Approximately 21% of the isotope administered in gelatin capsules was retained after one day, but when the isotope was incorporated into natural food, the retention was only about 7%. It was inferred that under the conditions of the experiment, uptake from the environmental water was greater than uptake through the food chain. (auth)

11952 (JAERI-5003) ACTIVITIES OF THE HEALTH PHYSICS DIVISION IN JAERI (1961). Report No. 3. (Japan Atomic Energy Research Inst., Tokyo). Oct. 1961. 265p. (In Japanese)

Included are 49 papers discussing the activities of the Health Physics Division at JAERI for 1961 in the following areas: radiation control; records and data; research and development; and meteorological and oceanographical survey and observation. Separate abstracts were prepared for 23 papers. One paper was previously abstracted in NSA. (B.O.G.)

11953 (JAERI-5003(p.62-5)) RADIATION LEVELS AND RADIOACTIVE CONCENTRATION IN AIR, AND CONTAMINATION OF THE SURFACES IN LABORATORIES. (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

Practical data obtained from routine monitorings at JAERI are described. These data show that the radiation levels have been and are kept at lower than the maximum permissible levels. (auth)

11954 (JAERI-5003(p.79-88)) BACKGROUND RADIATION AND RADIOACTIVITY. (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

Backgrounds radiation levels and concentrations of radioactivity in air, soil, plants, vegetation, milk, fishes, water, and bottom silt which were collected and analyzed, in 1960, are given. The samples were collected in the site and surrounding areas up to 15 km in various directions. The background radiation levels have been fairly constant in the past 5 yr. No marked differences from month-to-month or from year-to-year have been observed. In general, the amount of fallout has continued to decrease since the latter part of 1959. (auth)

11955 (JAERI-5003(p.97-105) EXTERNAL EXPOSURE. MEASUREMENT OF BACKGROUND RADIATION. S. Moriuchi and T. Ishihara (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The results of preliminary experiments are reported

for measurement of the background radiation in Tokaimura. Instruments used in the experiments are a cylindrical ionization chamber with vibrating reed electrometer and side-window-type Geiger Müller tubes. The dose rates of cosmic and gamma radiations were measured in Tokaimura. (auth)

11956 (JAERI-5003(p.107-11) INTERNAL EXPOSURE. TOTAL BODY COUNTER. [PART] II. S. Suguri, M. Oshino, and S. Ohtani (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The results of studies on the natural activities of steel, lead, and paint, which are used for the total body counter, the background of the steel room and body radioactivities are described. The variation of the natural activity of mill steel was small, whereas that of virgin lead was large, and it was found that the selected lead could be used for the low level counting and that use of steel was not essential in the reduction of the background. The background of the NaI(Tl) crystal, 5 in. in diameter by 4 in. thick, was 376 cpm in the energy band from 80 to 1640 kev when shielded with 20 cm of steel and 3 mm of lead. On the other hand, the background of the same crystal in the same energy band was 497 cpm with the same shielding when the additional nine plastic scintillation counters and all the auxiliary fittings for whole body counting were set in the steel room, and the background was reduced to 446 cpm when the phantom was on the bed and the other conditions were the same as before. The phantoms which were used for the calibration of body-radioactivities are described. (auth)

11957 (JAERI-5003(p.112-14)) DETECTION AND DETERMINATION OF RADIOISOTOPES. DETERMINATION OF SMALL AMOUNTS OF RADIONUCLIDES IN THE PRIMARY COOLING WATER OF JRR-1. K. Ueno, I. Tsurumaki, and Chau-timg Chang (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

A sample of primary cooling water taken from the stainless steel loop of JRR-1 on June 10, 1960, has gamma activities. The sample solution was dried, dissolved with hydrochloric acid, and transferred to a Dowex 1 anion exchange resin column bed. The nuclides absorbed on the column were successively eluted with hydrochloric acid to separate fractions of chromium, manganese, cobalt, iron, and zinc. The gamma activities of the fractions were measured with a 256 channel pulse height analyzer. The results showed that the radionuclides found in the sample had been formed by activation of impurities and corrosive materials in the water. (auth)

11958 (JAERI-5003(p.117-18) ADSORPTION OF CARRIER-FREE RADIONUCLIDES WITH VERMICULITE. K. Ueno (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

It has been known that clay minerals absorb water, gas, and various inorganic ions. The adsorption of a few radioactive nuclides in neutral and acidic solutions with vermiculite is reported. (auth)

11959 (JAERI-5003(p.124-8)) EXTRACTION STUDIES OF THE TRIETHYLBENZYLAMMONIUM CHLORIDE–AMMONIUM THIOCYANATE–CHLOROFORM SYSTEMS. J. Yoshimura and K. Ueno (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

More recently, advantage has been of the use of thiocyanate complexing as a method of chemical separation. Quaternary ammonium salts have not been used for the extraction of metallic ions, nor studied systematically so far. Therefore, it is very interesting to study the use of these salts for the extraction of metal thiocyanate complexes. Behaviors of about sixty chemical elements, ranging from sodium to neptunium, have been studied in the metal thiocyanate complex triethylbenzylammonium salt-chloroform system. (auth)

11960 (JAERI-5003(p.129-33)) HAZARD ANALYSIS OF FISSION PRODUCT RELEASE. ON THE EXTERNAL EXPOSURE DOSE RECEIVED FROM RADIOACTIVE GAS UNIFORMLY DISTRIBUTED IN THE FINITE SPACE. S. Fukuda (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The calculation of maximum permissible concentrations for noble gases is based on the external dose a person would receive if he were immersed in a semispherical infinite cloud of radioactive gas. However, there is also need to know the dose received when the extension of the radioactive cloud is finite, because many cases of exposure have occurred from radioactive gas confined in a finite space. The external exposure dose by noble gases such as Ar^{41} is calculated when the shape and extension of the cloud are changed, and it is discussed which of the doses, whole body dose by gamma-rays and the skin dose by beta and gamma rays, becomes predominant as the radioactive cloud extends semispherically. (auth)

11961 (JAERI-5003(p.134-46)) EXPOSURE TO THE GASEOUS RADIOACTIVE WASTE DISCHARGED IN THE NORMAL OPERATION OF A REACTOR, AND SURFACE CONTAMINATION (CRITERION FOR GASEOUS WASTE DISCHARGE IN NORMAL OPERATION). T. Aoki, S. Sakagishi, N. Itoh, M. Kakuta, and N. Mito (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The average annual distribution of the gas concentrations was evaluated, taking into account the meteorological condition in the Tokai area through one year. Using the distribution curve, a comparison was made in the permissible amount between continuous and single discharges from the view point of MPC. Deposition of the long half-life nuclides, such as Sr^{90}, from normal operation was emphasized from the fact that the concentration of radioactivity in a small pond in the area may have a chance to exceed the MPC in water, even when the concentration in air is controlled below the MPC in air. (auth)

11962 (JAERI-5003(p.147-66)) ANALYSIS OF RADIATION EXPOSURE IN THE CASE OF REACTOR ACCIDENT AND THE RELATION BETWEEN SAFETY CRITERION AND EMERGENCY PROCEDURES. T. Aoki, S. Sakagishi, I. Miyanaga, T. Ishihara, N. Itoh, and M. Kakuta (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

Detailed analysis is reported of the external and internal exposures not only during the period of fission product release, but also in one year after the accident, taking into account the effect from the deposition. Besides the total body, the thyroid, bone, and lung are picked up as critical organs. Data and figures for the analytical calculations are given for application purposes. Monitoring method and control area are discussed in this connection. (auth)

11963 (JAERI-5003(p.167-73)) DECAY OF THE DELAYED GAMMA POWER FROM THE CORE OF THE SHE AFTER SHUTDOWN OF THE OPERATION. T. Misaka (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The external radiation exposure hazards of the personnel who have need to approach the core of the semi-homogenous experimental critical assembly (SHE) as soon as or within a relatively short time after the operation is shutdown have

been evaluated by the calculation of the delayed gamma power of the SHE. As the result, it is found to be desirable to wait one day or more before entering the SHE room, in order to minimize the external exposure hazards. (auth)

11964 (JAERI-5003(p.174-6)) TRANSPORTATION AND DIFFUSION OF RADIOACTIVE WASTE. CONCENTRATION OF FISSION PRODUCTS IN AIR DUE TO A NUCLEAR DETONATION. A. Kasai (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

Studies were made of the concentration of radionuclides in air from a nuclear detonation, two years after the detonation. A large volume air sampler was used for the sampling, and the air dusts were collected as suspension in October, 1960, by suction of 21000 m^3 and 13000 m^3 air. A determination of the radionuclides was made using a 256 channel pulse hight analyzer. As the results of the measurement Ru^{106}, Ce^{144}, Cs^{137}, etc. were detected, and the relative ratios of these nuclides were calculated from the gamma ray photopeak area. A chemical analysis of the same samples has been made for Sr^{90} and Cs^{137}. (auth)

11965 (JAERI-5003(p.177-81)) ENVIRONMENTAL RADIOACTIVITY AT THE JAERI FROM 1956 TO 1960. S. Hitomi (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

Total beta radioactivities in soil, plants, and water obtained in the JAERI site and surrounding areas from 1956 to 1960 are presented. Radioactive contamination caused by the facilities in the JAERI was not found. The average concentration of beta activity in soil was 30 $\mu\mu c/10$ g. Large differences between the samples collected in different years were found in all locations. The samples collected in April and July, 1959, had approximately twice as large a beta concentration as those collected during the same period in the preceding year. The variation is probably from fission products from nuclear detonations. The radioactivities in plants were similar to those in soil. Underground water contamination was not directly affected by fallout, so the radioactivity was rather constants. (auth)

11966 (JAERI-5003(p.182-3)) RADIATION MONITORING AND MEASUREMENT. NEW TYPE BELL-ALARM METER. T. Oshima and K. Minami (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

A new type of bell-alarm meter has been investigated. This bell-alarm meter consists of an ionization cheamber containing an electrometer-tube, and an oscillation circuit for high voltage, a crystal speaker, and two mercury cells. The maximum setting dose is 2.4 r. (auth)

11967 (JAERI-5003(p.184-7)) TRAIL MAKING OF A SCINTILLATION SURVEY-METER. K. Minami and K. Nagaoka (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The sensitivities of a pulse-counting-type scintillation survey-meter and a current-measurement-type scintillation survey-meter, in both of which plastic scintillators are incorporated, have been examined. As many plastic scintillators with a smaller effective atomic number than that of air are employed in the current-measurement-type survey-meter, the sensitivity of the survey-meter decreases in low energy regions. Therefore, the sensitivity in the low x- and gamma-ray energy regions has been improved by using plastic scintillators combined with intensifying-screens, for x rays, made of ZnS or $CdWO_4$. (auth)

11968 (JAERI-5003(p.188-90)) CHARACTERISTICS OF THE LARGE VOLUME AIR SAMPLER. A. Kasai and T. Ishihara (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

A large volume air sampler was installed to observe radioactive contamination of air around the Tokai Research Establishment. The sampling efficiency of the large volume air sampler was determined by measuring the natural radioactivities in the air dusts at the inlet and outlet of the sampler. A filter paper dust sampler and an electric dust sampler were used to collect air dusts at the inlet and outlet. Natural radioactivities in the air dusts collected by these samplers were measured using a low background counter and a 2π gas flow counter. A wind velocity in the large volume air sampler was measured with pitot tube and the suction volume was calculated. (auth)

11969 (JAERI-5003(p.191-5)) CONTINUOUS MONITOR FOR RADIOACTIVE ARGON GAS. T. Ishihara and S. Sasaki (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The continuous differential ionization chamber type gas monitor was designed to measure radio-argon emitted from a reactor stack. After leaving the stack, the Ar^{41} is diffused by atmospheric turbulence, and increases ground radiation levels. The levels can be easily measured with the GM counter or scintillation counter, but it is difficult to measure the concentration. In recent years several theoretical advances have been made in the study of atmospheric diffusion. The sensitivity of this monitor is 6×10^{-8} $\mu c/ml$ Ar^{41}, so it can be used as a sensitive monitor of radioactive gases or as a quantitative measuring device for atmospheric diffusion. (auth)

11970 (JAERI-5003(p.203-8)) ANALYSIS OF THE AIRBORNE ACTIVITY IN THE SHE ROOM RESULTING FROM THE LOW POWER OPERATION OF THE SEMI-HOMOGENEOUS EXPERIMENTAL CRITICAL ASSEMBLY. T. Misaka (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The airborne activities resulting from the low power operation of the Semi-Homogeneous Experimental Critical Assembly have been studied. The phenomenon is found to have been caused by the teflon-coated fuel elements of UO_2-graphite pellets. The activities detected are attributed mainly to the decay of several daughters of the noble gas fission products. The phenomenon is characterized by an effective half-life of about 15 to 33 min. and is interpreted to be of low radiotoxicity. Use of satisfactory exhaust ventilation or respiratory equipment is recommended to keep the personnel internal exposure to a minimum when entering the critical assembly room after a certain operation. (auth)

11971 (JAERI-5003(p.209-14)) CALIBRATION OF THE THERMAL NEUTRON AREA MONITOR BY MEANS OF THE IN-FOIL ACTIVATION METHOD. T. Misaka (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The calibration of the thermal neutron area monitor has been made by the most useful method, that is, In-foil activation method. The neutron sources used in the experiment were about 100 and 1000 mc of Ra-Be. And the induced activity of the foil was measured by the 4π gas-flow counter which is operated in the proportional region. From this experiment it is found that the sensitivity of the BF_3-Counter (defined as cps/unit neutron flux) decreases with the increase of incident thermal neutron flux, the sensitivity varying from about 1.0 to about 0.7 at the incident fluxes 20 and 10^5 $n/cm^2 \cdot sec$, respectively. It is also found that the monitor indicates higher values than the true thermal neutron fluxes. (auth)

11972 (JAERI-5003(p.234-5)) DIURNAL VARIATION OF ATMOSPHERIC STABILITY. N. Itoh and T. Kashiwa (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

An evaluation of the atmospheric diffusion has been made by a semi-experimental equation, in connection with the reactor hazard analysis. In the equation the atmospheric stability is an important factor to determine both the horizontal and vertical diffusion widths. The results of analysis of the diurnal variation at Tokai-mura are shown. (auth)

11973 (JAERI-5003(p.246-50)) EVALUATION OF THE OCEANIC DIFFUSION. N. Itoh (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

It is important to estimate the dilution of radioactive effluents which diffuse into the sea water as well as the atmospheric diffusion of smoke from a stack. Many oceanographical observations and several dye-release experiments have been made in the sea area off the coast of Tokai-mura for the past several years. Presented are the results and the general relations between diffusion coefficients and sea water conditions. An evaluation of the dilution rate at a given point from the release point is tried. (auth)

11974 (JAERI-5003(p.251-5)) DIFFUSION EXPERIMENTS. STUDIES OF THE ATMOSPHERIC DIFFUSION BY SMOKE PHOTOGRAPHY. M. Kakuta and K. Imai (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

In order to reduce the manpower required in sampling in the field diffusion experiment, photographic observations of smoke have been developed. Following the first experiment on January 21, 1960, when merely photographs of horizontal spreads were taken, the second smoke experiment was undertaken on Oct. 5, 1960. At the time 10 second interval photographs of both the horizontal and vertical spreads were taken. The procedures and the results of the experiment are described. Analysis of the data showed that the vertical diffusion width is much larger than those given previously. From the results, it is felt that much attention should be given to the surface condition of the site for the evaluation of diffusion parameters. (auth)

11975 (JAERI-5003(p.256-8)) DIFFUSION EXPERIMENT OFF THE COAST OF TOKAI-MURA. Y. Tanigawa and Y. Sasanuma (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The dye-release experiment was performed on August 4, 1960, off the coast of Tokai-mura. A fluorescent substance was released at the outlet of a waste water pipe. To simulate the actual release of low level waste, dye was released continuously for 7 hr, which is different from the earlier experiments. The method used and the results of the experiment are described. (auth)

11976 (NYO-9530) STUDIES OF NUCLEAR DEBRIS IN PRECIPITATION. Summary Report. Progress Report No. 7. Alan Walton and Ralph E. Fried (Isotopes, Inc., Westwood, N. J.). Aug. 15, 1961. Contract AT(30-1)-2415. 106p.

A summary report was prepared from the studies of nuclear debris in precipitation samples at Westwood, New Jersey. Particular attention is also given to descriptions of the methods of collection and to the radiochemical procedures used for the assay of certain radionuclides such as Sr^{90}, Sr^{89}, W^{185}, Ce^{144}, Ba^{140}, and Pu. The deposition of Sr^{90} in precipitation for the period 1957-61 is discussed. Spring peaks in the Sr^{90} concentrations in precipitation are clearly visible each year. The 1961 peak was found to be as high as in 1960 and with the increased rainfall at Westwood, New Jersey the actual deposition of Sr^{90} activity was greater in the spring of 1961 than in the spring of 1960. Some comments on the concept of stratospheric residence times and the dangers inherent in making such calculations from the observations at one ground-level station are presented. Isotope ratio results such as Ba^{140}/Sr^{90}, Ce^{144}/Sr^{90}, and W^{185}/Sr^{90} were used to determine the age and origin of debris over the time interval 1958–1960. An inverse correlation between Sr^{90} concentrations and the amount of precipitation in individual storms was observed and the implications of this finding were discussed. (auth)

11977 (TID-15117) ENVIRONMENTAL RADIATION MONITORING. Quarterly Report, Fourth Quarter, October–November–December 1961. (Duquesne Light Co., Shippingport, Penna.). Contract [AT(11-1)-292]. 14p.

Data are tabulated on levels of background radiation, radioactivity in Ohio River water samples, and fall-out radioactivity in the vicinity of the Shippingport Power Station from October through December 1961. (C.H.)

11978 (TID-15121) STUDY OF THE FEASIBILITY OF SHIPPING THE FIRST SPENT CORE FROM ELK RIVER, MINN. TO POLICORO, ITALY. Final Report, August 1 to September 15, 1961. Stephen J. Fraenkel (Stanray Corp., Chicago). Sept. 15, 1961. Contract AT(11-1)-963. 32p.

A study was conducted to assess the feasibility of transporting the first spent core of the Elk River Power Reactor to Policoro, Italy. Commercial transport arrangements were also examined and it was found that changes in indemnity and/or insurance are required. Other aspects appear favorable. (J.R.D.)

11979 (UCRL-9711) PROCEDURES FOR THE DESIGN AND OPERATION OF HAZARDOUS RESEARCH EQUIPMENT. (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 31, 1961. Contract W-7405-Eng-48. 75p.

Procedures are presented for safe design and operation of hazardous research equipment such as H targets, bubble chambers, and high-pressure gas apparatuses. The procedures and information are presented in sections on flammable fluid-associated equipment, high-pressure gas equipment, and liquid H- and He-associated equipment. (J.R.D.)

11980 (WT-770) THERMAL RADIATION PROTECTION AFFORDED TEST ANIMALS BY FABRIC ASSEMBLIES. J. Fred Oesterling (Quartermaster Research and Development Labs., Philadelphia; Army Medical Service Graduate School, Washington, D. C.; Walter Reed Army Medical Center, Washington, D. C.; and Rochester, N. Y. Univ. Atomic Energy Project). July 1955. Project 8.5 of Operation UPSHOT-KNOTHOLE. 59p.

Chester white pigs, clothed in Armed Services fabric assemblies or placed behind a series of open or fabric-covered portholes, were exposed to the effects of thermal radiation from atomic explosions. Three different fabric assemblies were tested, each with and without a fire resistant treatment on the outer layer. The tests were carried out to determine the protective value of a limited number of clothing combinations, to obtain field information that could be related to laboratory data on fabric protective characteristics, to investigate the value of a fire resistant treatment in reducing thermal injuries, and to study the effect of various details of clothing design on thermal protection. Data are tabulated and results are illustrated photographically. (C.H.)

11981 POTENTIAL EXPOSURES FROM X-RAY AND SEALED RADIOISOTOPES. R. G. McAllister (Liberty

Mutual Insurance Co., Hopkinton, Mass.). Arch. Environmental Health, 4: 265-72(Mar. 1962).

Potential hazards from the use of x-ray machines and sealed γ-sources for industrial radiography are discussed. Twenty-five-Mev betatrons are being used to inspect certain types of military hardware and 50c Ir^{192} and 10c Co^{60} sealed sources are now commonplace in industry. The usual range of the thousands of industrial x-ray machines used in this country is between 150 and 300 kvp. Extensive use of portable x-ray machines and sealed sources, under a variety of difficult control conditions, makes the evaluation of radiation damage to radiographers, workmen in the immediate area, and to the public difficult. Proposals are presented for an effective control program for industrial radiography. (C.H.)

11982 METHODS FOR THE SITE SELECTION OF REACTOR PLANTS ON THE BASIS OF NUCLEAR VIEWPOINTS. Erich Stauber (AEG-Kernenergieanlagen, Frankfurt am Main). Atom u. Strom, 7: 87-91(Nov. 1961). (In German)

An evaluation of the worst conceivable accident must be considered in the selection of reactor sites. A general method for estimating the safety of a site is given on the basis of a conservative, and as realistic as possible, evaluation of the consequences of such an accident. The time dependent free fall of radioactive material after an accident is considered also. (tr-auth)

11983 OBSERVATION AND EVALUATION OF AN INCREASE IN THE RADIOACTIVITY CONTENT OF FALLOUT IN APRIL 1960. H. Bernhardt (Laboratorium des Wahnbachtalsperrenverbandes, Siegburg, Ger.). Atompraxis, 8: 41-7(Feb. 1962). (In German)

The increase in fall-out radioactivity observed in April 1960, was identified as short-lived fission-products by means of decay-curve recordings. Use of the t^{-1} rule made it possible to determine a common date of origin for the various fall-out samples, which were produced by uranium nuclear fission. The practical importance of such evaluations of continuous activity measurements of fall-out for water-supply plants with surface water is stressed. (auth)

11984 THE Sr^{90} CONTENT OF HUMAN BONE AND TISSUE. O. Pribilla (Universität, Kiel). Atompraxis, 8: 48-50(Feb. 1962). (In German)

Results of measurements of Sr^{90} in human bones in Western Germany from 1958 to 1960 are given. In 1959 the average values in the bones of newborn infants increased to 1.56 pc/g Ca. In 1960 these values dropped back to the 1958 level. A further rise in Sr^{90} contamination of the bones is expected in the 0- to 5-year-old group. In 1960 the peak value was found in the one-year-old group. The values found in the bones of newborn infants are in linear relation to the annual averages of Sr^{90} contamination of milk for these particular years. In conclusion, the results of studies of the Sr^{90} content of human testicular tissue are given. (auth)

11985 THE SUPERSONIC DECONTAMINATION OF GLASS EQUIPMENT CONTAMINATED WITH P^{32}. B. Schmidt, D. Hartmann, and K. Grossgebauer (Universität, Berlin). Atompraxis, 8: 65-6(Feb. 1962). (In German)

It was found that glass equipment contaminated with P^{32} can be decontaminated most effectively by using supersonics with a detergent additive. Other methods are given for comparison. (auth)

11986 THREE YEARS OF DAILY MEASUREMENTS OF THE LONGLIVED ATMOSPHERIC β RADIOACTIVITY AT THE SACLAY CENTRE D'ETUDES NUCLEAIRES (1958-1959-1960). A. Doury and H. Francois. Bull. inform. sci. et tech. (Paris), No. 56, 14-27(Nov. 1961). (In French)

A systematic check on longlived atmospheric radioactivity using samples of dust and precipitations was made. The main methods of sample-taking and analysis are reviewed briefly: high-output pumps, filters, rain gauges, collectors, evaporations and calcinations, and counting. The results are presented for atmospheric dusts, and precipitations. After a perturbed year, 1958, and the first half of 1959 which showed the maximum and the most persistant activities, a rapid and continuous decrease is shown; the low levels were maintained September 1, 1961, and were disturbed only to a negligible extent in 1960 by the Sahara experiments. (auth)

11987 CONTRIBUTION TO THE FILM DOSIMETRY OF ENERGETIC QUANTUM RADIATION. II. EXPERIMENTAL RESULTS. K. Becker. Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed., 95: 839-47(Dec. 1961). (In German)

From the incorporation of p-terphenyl as scintillator in a high speed x-ray emulsion, favorable results may be expected for the following reasons. The energy dependence of the blackening-dose relationship increases with decreasing sensitivity of the emulsion. The fading of the latent image is more marked on low-speed emulsions. On very insensitive emulsions reciprocity failure occurs. On account of theoretical considerations the increase of energy-independence and of speed in the gamma region with increasing terphenyl content is predicted from the experimental films. The dependence of the blackening per dose on the angle of incidence also decreases with increasing terphenyl content. (auth)

11988 BUSINESS CAN SAVE 70,000,000 LIVES. Kenneth W. Yarnold and Robert C. Suggs (Dunlap and Associates, Inc., Stamford, Conn.). Harvard Business Rev., 39: No. 6, 6-8; 12-13; 16; 20; 22; 24-5; 190; 192 (Nov.-Dec. 1961).

Discussion is given on the thermonuclear threat, the effects of thermonuclear weapons, and the types of protection required against these effects; requirements for a minimal type of fall-out shelter, in terms of both physical structure and ancillary equipment; ways in which various types of buildings in everyday commercial and industrial use fulfill the requirements for shelters, and the methods of modifying buildings to incorporate such provisions; and the elements of sound planning for the use of shelters. Actual examples and building plans are used to show what can and should be done. It is felt that a sound shelter program carried out by industry and local government could save up to 70 million lives in a heavy thermonuclear attack (depending on the areas bombed and weather conditions). (P.C.H.)

11989 HEALTH DOSIMETRY OF CORPUSCULAR RADIATION BY A PHOTOGRAPHIC METHOD. Jaroslav Beneš (Inst. of Nuclear Research, Czechoslovak Academy of Sciences [Prague]). Jaderná energie, 8: 15-20(1962). (In Czech)

A brief survey of film dosimetry of corpuscular radiation is given. Experience in this field is summarized, and the results of thermal neutron dosimetric control of reactor and cyclotron operators are reported. (auth)

11990 CALORIMETRIC METHODS IN IONIZATION RADIATION DOSIMETRY. [PART] I. Zdenek Kovář (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 8: 51-6(1962). (In Czech.)

Some typical calorimeters used in absolute dosimetry of

natural and artificial radioisotopes, for radium standards calibration, and in reactor dosimetry are briefly described. The methods for using the calorimeters and the results obtained are reported. (auth)

11991 METHODS OF CONTROL OF EXPOSURE TO RADIATION IN FACTORIES. I. K. B. Legge (Ministry of Labour, London). Roy. Soc. Health J., 81: 237-42(Sept.-Oct. 1961).

Protective measures are outlined for risks from x and gamma rays and alpha and beta particles. Discussion is given on the maximum permissible dose, principles of protection; personal protection; monitoring, training, and medical control; and practical applications with x and gamma radiography, x-ray fluoroscopy, static eliminators and measuring devices, and storage and transport. (P.C.H.)

11992 SAFETY AND RADIATION PROTECTION IN THE JÜLICH NUCLEAR RESEARCH PLANT. Walter Schroeck-Vietor (Kernforschungsanlage, Jülich, Ger.). Tech. Überwach., 2: 291-6(Aug. 1961). (In German)

In the selection of the location and the construction of the nuclear research plant in Jülich, safety and radiation protection were taken into account with regard to the subsequent operation of the reactor. The safety organization is of considerable importance in all departments. The departmental protection described comprehensively embraces the supervisory services and the principles of radiation protection which in each case are incorporated in three functional fields. Measurements have been taken for a few years, and some of the results are given. (au

11993 WATER DECONTAMINATION FROM RADIOACTIVE SUBSTANCES. A. S. Smirnov. Zhur. Vsesoyuz. Khim. Obshchestva im. D. I. Mendeleeva, 5: 651-7(1960).

A summary is given of the existing methods of water decontamination from radioactive substances, the disadvantages and favorable aspects of each, and the difficulties encountered. Special mention is made of the causes of radioactivity in waters, both natural and synthetic. Systematic checks of the radioactive content in different water systems are suggested. Discussion is given on the following methods: deactivation of natural water supplies, coagulation, filtration through sand, lime soda softening in coprecipitation, and ion exchange. It is concluded that, according to literature data, the ionic exchange method is the most effective, especially for small water mains. (P.C.H.)

11994 DOSEMETERS FOR X-RAY DIAGNOSIS. K. Reinsma. Translated by A. F. Jolmers. Eindhoven, Netherlands, N. V. Philips' Gloeilampenfabrieken, 1962. 97p.

Dosimeters (ionization chambers and the associated electronic circuits) which evaluate the total radiation energy absorbed by patients during medical x-ray examinations are described. Information is given on the design, construction, and calibration of ionization chambers and the measuring circuits. Two methods for calibration are given and compared. The measurements carried out with these dosimeters on approximately one thousand patients in the x-ray departments in two hospitals in the Netherlands are given, together with the conclusions drawn from these results. (N.W.R.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

11995 (MLM-1127) NUCLEAR BATTERY-THERMOCOUPLE TYPE SUMMARY REPORT. B. C. Blanke, J. H. Birden, K. C. Jordan, and E. L. Murphy (Mound Lab., Miamisburg, Ohio). Oct. 1, 1960. Contracts AT(33-1)-GEN-53 and R-65-8-99811-SC-03-91. 68p.

The potential usefulness of approximately 1300 radioactive isotopes as a heat source for the thermoelectric generator was investigated. Only 47 were found to have the proper characteristics of high specific activity and usable half-life combined with an easily absorbable radiation. These isotopes are discussed showing possible sources of supply, the hazards involved, and the expected performance. Three large Po^{210} heat sources were designed and constructed (for battery use), including one for the SNAP III generator. One small Tl^{204} test heat source was made by irradiation. Eight thermoelectric generators were developed and two of these were used as thermoelectric batteries. Theoretical equations for non-semiconductor thermoelectric materials and experimental measurements to verify the Thompson and Peltier effects are given. (auth)

11996 (MND-P-2613) FINAL SAFETY ANALYSIS; TEN-WATT STRONTIUM-90 FUELED GENERATOR FOR AN UNATTENDED LIGHT BUOY, SNAP-7A. (Martin Co. Nuclear Div., Baltimore). [1961]. Contract AT(30-3)-217. 51p.

The results are presented of a safety analysis of a prototype strontium-90 fueled generator. The fuel capsules produce 256.5 watts(t), from the decay energy, which is converted to 10 watts(e), with a 5 watt net output from the batteries. The generator can be safely transported and operated with normal precautions afforded any structure containing a radioisotope. The shielding provided is adequate for protection against direct radiation exposure. The integrity of the system is maintained under most conceivable accident conditions. (B.O.G.)

11997 (MND-P-2614) FINAL SAFETY ANALYSIS; TEN-WATT STRONTIUM-90 FUELED GENERATOR FOR AN UNATTENDED METEOROLOGICAL STATION. SNAP-7C. Phillip M. Brooks (Martin Co. Nuclear Div., Baltimore). [1961]. 51p.

The analysis indicated that the generator can be safely transported and operated with the normal precautions afforded any structure containing a radioisotope. The shielding provided for protection against direct radiation exposure is considered adequate. Integrity of the system is maintained under most conceivable accident conditions. The insolubility and chemical stability of the radiostrontium titanate is incidental as long as containment is maintained. (B.O.G.)

11998 (NP-11380) MESURE EN PROFONDEUR DE LA TENEUR EN EAU DES SOLS PAR RALENTISSEMENT DES NEUTRONS RAPIDES. (Measurement of the Depth and Content of Water of Soils by Slowing-Down of Fast Neutrons). C. Andrieux, L. Buscarlet, J. Guitton, and B. Merite (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 55p.

Presented at a Colloquium, Bombay, February 26–March 2, 1962.

A portable apparatus is described, consisting of a Ra–Be fast neutron source and a BF_3 thermal-neutron detector plus associated electronic counting and integrating circuitry, whose purpose is the measurement of the water content of soils. Theoretical aspects of the neutron collisions with the H atoms in water are outlined, in order to explain the thermalization and capture of the neutrons. The effects of the detection geometry are studied. Methods for calibrating the apparatus and for determining its precision are reviewed. (T.F.H.)

11999 (NYO-9853) INVESTIGATION OF RADIOISOTOPE TECHNIQUES FOR ATMOSPHERIC DENSITY MEASUREMENTS AND THE DEVELOPMENT OF A DEVICE. Task Summary Report on Phase I, June–December 1961. (Parametrics, Inc., Saxonville, Mass.). Jan. 30, 1962. Contract AT(30-1)-2795. 81p.

Work was undertaken for the purpose of determining the feasibility, and the optimum design of an atmospheric density gauge using radioisotope techniques for use in a balloon sonde at altitudes up to 140,000 ft. Methods considered include electron-induced optical fluorescence, electron-bremsstrahlung, alpha range-energy, gamma and x-ray attenuation and scattering, and beta attenuation and scattering. Of these, beta scattering was found superior on the basis of cost, simplicity of apparatus and minimal required source strength. Design requirements associated with the beta scatter gauge such as type of source, source-shield-detector geometry, type of detector, background compensation, and the necessary electronic circuits were determined for optimum gauge performance. It is possible to make a beta scatter gauge for balloon sonde use that will provide a measurement of atmospheric density to better than 1% from 80,000 to 140,000 ft. using several millicuries of Kr^{85} as a source. This gauge can be made compatible with the present Weather Bureau sonde and ground station equipment. Precise cost is difficult to estimate but it appears that the price of this gauge should be less than $100 in volume production. (auth)

12000 (TID-13439) THE HIGH INTENSITY FOOD IRRADIATOR REPORT NO. 17. Final Report on THE HIGH INTENSITY FOOD IRRADIATOR DESIGN. (Curtiss-Wright Corp., Princeton, N. J.). May 1, 1960. Contract AT(04-3)-200. 259p.

The High Intensity Food Irradiator was designed for the irradiation of large rectangular packages by means of exposure to plaque-type Co^{60} radiators. Data are presented from preliminary design analyses, experimental measurements, a computational program, and analytical studies. A general discussion of source design principles is included. The results are summarized in graphs and formulas that may be applied to other design requirements. (C.H.)

12001 (JPRS-12791) THE USE OF IONIZING RADIATIONS FOR CONTROL OF DORMANCY IN POTATOES DURING STORAGE. B. A. Rubin, L. V. Metlitskii (Metlitskiy), E. (Ye.) G. Sal'kova, E. (Ye.) N. Mukhin, N. P. Korableva, and N. P. Morozova. Translated from Biokhim. Plodov i Ovoshchei, Akad. Nauk S.S.S.R., Inst. Biokhim. im. A. N. Bakha, 6: No. 6, 5-57(1961). 93p.

Studies were conducted on the radiation effects on carbohydrate metabolism, nucleic acid metabolism, and the re-

sistance of tubers to microorganisms and disease in the potato. The purpose of the studies was to investigate the possibility of using radiation to suppress the sprouting of potato tubers without damaging their resistance to microorganisms and disease and to preserve potatoes for a whole year of storage without artificial refrigeration. (D.L.C.)

12002 (NP-tr-866) LUMINOUS MATERIAL AND ITS PROCESS OF MANUFACTURE. K. W. Lange. Translated by S. Fitzgerald (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from French Patent No. 1,133,803. Apr. 2, 1957. 22p.

A self-luminous material is described which comprises luminophore particles enveloped in a coating of a pure beta emitter. Many methods are given for the manufacture of the coated luminophores: (1) a dried mass of small luminescent crystals is wetted with a solution of a beta-emitting salt, e.g., $Sr^{90}(NO_3)_2$, and then with a $(NH_4)_2CO_3$ solution to precipitate $Sr^{90}CO_3$ on the crystals. An intermediate layer may be used to decelerate the beta rays and thus prevent destruction of the luminescent centers. (2) Radioactive atoms, e.g., Sr^{90}, are incorporated into the crystalline lattice by electrical or thermal diffusion. (3) An organic compound containing tritium is polymerized in contact with the luminescent crystals. Some applications of the luminophores in organic chemistry are described, particularly the use as u-v sources for irradiation of microorganisms or cells. (D.L.C.)

12003 USES OF NUCLEAR RADIATION IN THE TEXTILE INDUSTRY. Robert Roberts (Wantage Research Lab., Berks, Eng.). New Scientist, 13: 450-2 (Feb. 22, 1962).

The applications of radiation in the textile industry are discussed and briefly described. The chief applications are in grafting materials to fiber molecules to minimize static electricity, to improve dyeing methods, and to make waterproof material. The graft copolymerization process is described. (N.W.R.)

ISOTOPE SEPARATION

12004 (KFK-tr-60) ISOTOPENTRENNUNG NACH DEM TRENNDUSENVERFAHREN. (Isotope Separation by the Separating Nozzle Process). H[isashi] Mikami and Y[oshitoshi] Oyama. Translated into German by Peter Buriks (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Germany) from Nippon Genshiryoku Gakkaishi, 2: 291-5(May 1960). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 18085.

12005 PRODUCTION OF HEAVY WATER FOR REACTORS. F. Bolhâr-Nordenkampf. Electrotech. u. Maschinenbau, 77: 387-90(Sept. 1, 1960). (In German)

The different methods of producing heavy water including gas-liquid, distillation, electrolytic, and liquid-liquid substitution processes are discussed, and the advantages and disadvantages of each are lsited. Present production of heavy water is reported and future demands are analyzed. (M.C.G.)

12006 ISOTOPE TRANSPORT PHENOMENA IN LIQUID METALS (thesis). Alexander R. E. Lodding (Chalmers Tekniska Hogskola, Goteborg). Goteborg, Elanders Boktryckeri AB, 1961. 71p. Sw. Kr. 10:-.

The isotope enrichment effect of electromigration in molten metals ("Haeffner effect") was investigated in Rb between 70 and 400°C, in K between 80 and 250°C, and in In between 200 and 550°C. The reliability of older measurements on Hg, Ga, K, In, Sn, Cd, Zn, Li, and Rb is discussed and some of the results corrected. All available Haeffner effect data are summarized and the temperature dependence shown. The effective self-diffusion coefficients of Rb, K, and In are computed within wide temperature ranges. An attempt is made to interpret the Haeffner effect on the basis of self-transport motion induced by electron friction and Coulomb forces acting on ions just engaged in diffusion. The diffusion model based on small cooperative position adjustments of groups of atoms gives better agreement with experimental data than does a conventional hole model. (auth)

12007 ISOTOPIC FRACTIONATION OF NITROGEN IN THE NITROGEN OXIDE–NITRATE EXCHANGE SYSTEM. Marvin J. Stern, Lois Nash Kauder, and W. Spindel (Rutgers Univ., Newark, N. J.). J. Chem. Phys., 36: 764-72(Feb. 1, 1962).

The single-stage fractionation factors for nitrogen exchange between nitric oxide and nitrate salt solutions were found to range from 1.073 at 25° to 1.056 at 70°. The experimental values are about 0.007 less than the values calculated from spectroscopic data, a result not unexpected, since the statistical mechanical calculations do not take interactions in a condensed phase into account. Within the estimated experimental error of ±0.004, the isotope effect appears to be independent of the nature and degree of complexing of the nitrate ion in solution. Measurements were also made of the fractionation factors between nitric oxide and nitric acid solutions (1–12 M) over the temperature range 25–70°. The formation of additional oxy-nitrogen species in both phases introduces additional exchange reactions which lower the over-all isotope effect significantly. Due to the changes in the chemical compositions of the phases, the observed factors go through a maximum in the vicinity of 6 M nitric acid. The experimental effective fractionation factors are in general agreement with the values calculated from the chemical compositions of the systems and the partition function ratios for the chemical species involved. (auth)

12008 THEORETICAL CONSIDERATION OF LIQUID-VAPOR EQUILIBRIUM OF ISOTOPE MIXTURE UNDER CENTRIFUGAL FORCE. Kazuo Amaya. Repts. Govt. Chem. Ind. Research Inst., Tokyo, 57: 1-3(Jan. 1962). (In Japanese)

For estimating concentration efficiency, theoretical expressions for the equilibrium distribution of the components in liquid and vapor phases under centrifugal force were derived. By the use of these expressions, the efficiency of concentration of $U^{235}F_6$ under accessible conditions was calculated for mixtures of $U^{235}F_6$ and $U^{238}F_6$ in various ratios. It is deduced that the efficient concentration of $U^{235}F_6$ will be possible if an appropriate apparatus for successive distillation can be constructed. (auth)

12009 A THERMODIFFUSION INSTALLATION FOR TRITIUM FOR THE PREPARATION OF LOW TRITIUM CONCENTRATIONS. Bernhard Gonsior (Universität, Heidelberg and Universität, Cologne). Z. angew. Phys., 13: 545-8(Dec. 1961). (In German)

The thermodiffusion separation plant for tritium is described. The essential disadvantage of the usual methods (electrolysis, distillation, etc) for tritium enrichment is that accurate separation factors are not known, and accordingly inaccuracies in the calculation of the final tritium concentration occur. The installation described avoids this disadvantage since it extracts the total tritium content of a given hydrogen sample. The knowledge of separation factors is not necessary in this method since the tritium concentration is obtained directly with good accuracy by subsequent activity measurements in given hydrogen aliquots. (tr-auth)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 11436 and 11861

12010 (CRE-1028) PROGRAMMING THE LGP-30 COMPUTER. J. N. Elliott (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1960. Reprinted June 1961. 82p. (AECL-1270)

The LGP-30 is a drum-storage, all-binary digital computer with 4096 cells of memory capacity. The cells are of 31-binary-digit length or the equivalent of 9 decimal digits. Input and output subroutines are used to translate from decimal to binary and vice versa. Communication to and from the machine is through a flexowriter or photoreader and high-speed punch. There are over 500 of these computers in use. (auth)

12011 (CRT-723(Rev.Ed.)) LIBRARY ROUTINES FOR USE WITH THE CHALK RIVER DATATRON. P. M. Attree, ed. (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Sept. 1959. 272p. (AECL-529)

Descriptions and program printouts are included of the library routines for use with the Chalk River Datatron, which are divided into three sections: (A) mathematical functions; (B) miscellaneous; and (C) mathematical analysis. Routines in group A are simple functions such as square root, exponential, and logarithm; group B are mainly organizational including input and output routines, with conversion to floating point, program checking routines, and routines for relocating stored data; group C include special purpose routines for integration of a function, matrix programs, integration of differential equations, and least squares fitting. (B.O.G.)

12012 (MND-C-2501) APWRC—CSDP, A GENERALIZED FORTRAN—II PROGRAM FOR AUTOMATED CROSS SECTION DATA REDUCTION AND ANALYSIS. R. S. Hubner (Martin Co. Nuclear Div., Baltimore). May 31, 1961. Contract AT(30-1)-2431. 391p.

FORTRAN-II programs written for the analysis of nuclear parameters describing neutron interactions with matter and for the preparation of magnetic tape libraries of these parameters based on any 1001 energy levels, or less are described. These programs, taken in the aggregate, are referred to as the Cross Section Data Program (CSDP). Basic parameters reported in the literature are processed and supplemented with analysis using the Breit-Wigner single-level formulas, analysis of differential elastic scattering data, and analysis of inelastic scattering nuclear level data. The resulting tape libraries provide the absorption, inelastic scattering, elastic scattering, fission cross sections, energy-dependent values of the average cosine of the scattering angle, the average logarithmic energy decrement, and the average number of neutrons emitted per fission. In addition, fission spectra and inelastic scattering matrices are available. Other options include combination of certain of the above parameters, combination of materials to produce a new material, flux weighting when reducing the number of energy levels, and computation of Maxwell-Boltzmann averaged thermal cross sections. The status of the tape libraries is given. Verification of data for selected materials by comparison with experimental results is also described. Automation is emphasized in all phases of data reduction and handling. (auth)

12013 (NDL-TR-21) "FLUX," AN IBM 704 CODE FOR THE PROCESSING OF NEUTRON-FLUX DATA FROM THE THRESHOLD-DETECTOR SYSTEM. John H. McNeilly, John W. Kinch, and Marion Sample (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.). Nov. 1961. 60p.

The IBM 704-8K program "FLUX" for the calculation of neutron flux from the threshold-detector data which are described, was tested and proved adequate. For a computer run having approximately 7,000 cards (before card processing), the running time on the IBM 704-8K is 0.24 hour. Hand calculations of the same data would require approximately 30 man days. (auth)

12014 (ORNL-3255) A FORTRAN SUBROUTINE FOR TABLE GENERATION BY DATA INTERPOLATION. S. K. Penny (Oak Ridge National Lab., Tenn.). Mar. 8, 1962. Contract W-7405-eng-26. 7p.

A FORTRAN subroutine was written for the purpose of generating a table of data by interpolation in a smaller table of data. There are four options for the interpolation scheme. The purpose is to provide information for a "table look-up" which is usually much less costly than direct computation. (auth)

12015 (RM-2869-PR) LIMITING DISTRIBUTIONS FOR CRITICAL MULTITYPE BRANCHING PROCESSES WITH DISCRETE TIME. T. W. Mullikin (RAND Corp., Santa Monica, Calif.). Dec. 1961. Contract AF 49(638)-700. 53p.

For a fairly general class of critical branching processes (i.e., processes in which the maximum eigenvalue of the expectation operator for one generation = 1), the population size of the n^{th} generation is investigated, assuming the $\underline{n}^{th}$ generation is not empty. Properties of Branch spaces are used to show that certain conditional probability distributions defined for the $\underline{n}^{th}$ generation have exponential limiting distributions as $\underline{n}$ tends to infinity. The results are used to examine an idealized spherical reactor containing monoenergetic neutrons. (T.F.H.)

12016 (SC-4672(M)) CALINT PROGRAMMING SYSTEM FOR CDC-160 COMPUTER. David L. Beckedorff and M. Katherine Weston (Sandia Corp., Albuquerque, N. Mex.). Feb. 1962. Contract [AT(29-1)-789]. 46p.

Supersedes SCTM-377-61(54).

The Calint programming systems for the CDC-160 computer is described and the available operations are indicated. Proper format for input to the computer and operation of the computer are discussed. The subroutines for transcendental functions which were written in Calint are described. A brief discussion on storage allocation is included. Other library routines available to the Calint programmer are mentioned. (auth)

12017 (TID-15203) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. DATA REDUCTION METHODS. PART IV. ILLIAC USE AND OPERATION. PART V. IBM 650 USE AND OPERATION. PART VI. INSTRUCTIONAL USE OF COMPUTERS. PART VII. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Dec. 1961. Contract AT(11-1)-415. 42p.

Progress toward completion of the computer is summarized. Circuit design is reported on failsafe indicators and the transistorized section of a high-speed counter. Other work includes experiments with saturating transistors and analysis of a probabilistic circuit. Operational activities

related to the ILLIAC and IBM 650 are summarized. A summary is also included on computer instructional use. (J.R.D.)

12018 (WAPD-T-1356) SOLUTION OF THIN PLATE PROBLEMS BY THE METHOD OF FINITE TRANSFORMS. Stanley Kaplan (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1961. Contract AT-11-1-GEN-14. 21p.

A general formulation of the method of finite transforms as applied to problems in the deflection of thin plates is presented. For any one of a broad class of such problems the formulation identifies a convenient set of eigenfunctions for expanding the deflection and determines each expansion coefficient as the solution of an ordinary differential equation or, in the time independent case, of a simple algebraic equation. (auth)

12019 POTENTIALS FOR DENUMERABLE MARKOV CHAINS. John G. Kemeny and J. Laurie Snell (Dartmouth Coll., Hanover, N. H.). J. Math. Anal. and Appls., 3: 196-260(Oct. 1961).

A unified treatment of potentials for general Markov chains is presented. Basic properties of potentials associated with transient chains are reviewed; these behave like Newtonian potentials. Potentials for recurrent chains are developed; they behave like logarithmic potentials. The discrete analog of the Newtonian potential classical theory is obtained by applying these results to random walls in 3 dimensions. Since the results are applicable to Markov chains in general, discrete versions of the more general theory are obtained. (L.N.N.)

12020 FIELD-THEORY ANALOGS OF THE LAGRANGE AND POINCARÉ INVARIANTS. P. A. Sturrock (Stanford Univ., Calif.). J. Math. Phys., 3: 43-50(Jan.-Feb. 1962).

The Lagrange differential invariant and the Poincaré integral invariant of classical dynamics have as their analogs in Lagrangian field theory a "differential divergence-free vector" and an "integral divergence-free vector." The former, which is experssible as a divergence-free vector-bracket expression, may be used to derive conservation relations associated with the transformation properties of a given system. It is not necessary that these transformations should be infinitesimal; conservation theorems are established for systems which are periodic and for systems which are invariant under spatial inversion. The differential divergence-free vector may also be used to establish reciprocity and orthogonality relations: examples discussed are Betti's reciprocal theorem of elasticity and Lorentz's reciprocal relation of electromagnetic theory. An extended form of the differential divergence-free vector allows for variation not only of the dependent variables but also of the independent variables. The integral divergence-free vector associates a conserved quantity with any closed one-parameter family of solutions of the field equations. The "equation of conservation of probability" of quantum mechanics and a classical form of the relation between the momentum and wave vectors for a plane wave in a propagating medium are derived. The theorem of classical dynamics relating a complete set of Poisson brackets to a complete set of Lagrange brackets cannot be extended to the present formalism. The formula that represents the obvious extension of the classical formula for the Poisson bracket can be shown not to be canonically invariant. (auth)

12021 SOME PHYSICAL SOLUTIONS OF DIRAC-TYPE EQUATIONS. Jack K. Hale and Arnold P. Stokes (RIAS, Baltimore). J. Math. Phys., 3: 70-4(Jan.-Feb. 1962).

The Dirac equation of classical electrodynamics is a third-order differential equation. Sufficient conditions on the force field insuring that there are solutions of Dirac's equation that approach a motion with constant velocity as time increases are given. (auth)

12022 USE OF THE DISPLACEMENT VECTOR IN ELECTROMAGNETIC THEORY. K. G. Dedrick and Robert N. Wilson (Stanford Univ., Calif.). J. Math. Phys., 3: 97-105(Jan.-Feb. 1962).

Problems in the electrodynamics of charged fluids often require calculation of the charge and current densities, given prior knowledge of the initial distributions and the displacement vector field. Solutions are obtained for these new distributions, with the property that if the initial distributions have a sharply defined boundary, terms arise which can be interpreted as distributions of electric charge and current multipoles located on the initial boundary surface. These solutions cannot be considered valid near the initial boundary, but prove to be useful in that many of their properties are given correctly. The electromagnetic potentials due to the charge and current densities in the displaced configuration are calculated, and form the basis for a discussion of the complicated boundary value problem encountered in the description of the electrodynamics near the boundary surface. Results are directly applicable to the theory of high frequency electron tubes, and formulas are of use in hydrodynamics and elasticity. (auth)

12023 MATHEMATICAL EXERCISES IN NUCLEAR ENGINEERING. G. Mardus (Technische Hochschule, Berlin). Kerntechnik, 4: 17-20(Jan. 1962). (In German)

A formulation was developed for calculating the thermal resonance escape factor for a homogeneous mixture of natural uranium with graphite, with light and heavy water. Equations are presented for a mono-energetic source and a uniform moderator consisting of a single nuclear species. Then these equations were modified for more complex relations. The energy dependence of the effective cross sections for the moderator was determined. Ordinary and effective resonance integrals were calculated. (M.C.G.)

12024 THERMODIFFUSIONAL SEPARATION OF OXYGEN ISOTOPES. I. A. Semiokhin, E. P. Ageev, G. M. Panchenkov, and B. I. Smirnov (Moscow State Univ.). Zhur. Fiz. Khim., 36: 124-9(Jan. 1962). (In Russian)

Results are reported from an investigation of the effects of pressure, rate of gas entry into the column, and filament temperature in the thermodiffusional separation of oxygen isotopes. It is shown that the rate of supply of gas from the reservoir to the column (or from one column to another) plays an important part in the rate of isotope separation. Jones and Ferri's theory were shown to be in qualitative agreement with the results obtained. A separation factor of S = 8.45 was attained at a filament temperature of 880°C in a 312 cm high column, a value considerably above those in the literature, comparable operative conditions. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

12025 (EURAEC-216) PRODUCTION OF MIXED UO_2–ThO_2 PELLETS BY AIR SINTERING. Final Report, September 1, 1960 through September 1, 1961. (Compagnie Industrielle des Combustibles Atomiques Frittes, Corbeville, par Orsay (Seine-et-Oise), France). Oct. 1961. Work Performed under United States–Euratom Joint Research and Development Program. 37p.

Sintering, both in air and in cracked ammonia, yielded high density (more than 96% of the theoretical value) mixed uranium and thorium oxides. Sintering in air at 1,600°C yielded solid ThO_2–$UO_{2.3}$ solutions. Sintering in hydrogen yielded solid ThO_2–$UO_{2.00}$ solutions. The successful outcome of the sintering is conditioned by the selection of the raw materials. The mixed precipitates of ThO_2–U_3O_8 yielded remarkable results when sintered in hydrogen, the addition of CaO made it possible to reduce the temperature to 1,400°C. The mixture of UO_3 and of ThO_2 is the most suitable for air sintering. An essential condition for the success of the sintering operation is a good homogeneity of the initial mixture. An investigation was made of the influence of the shaping conditions on the density after sintering and on the structure. The influence of the content percentage of the various constituents: from 0 to 15% uranium oxide and from 0 to 0.4% CaO was also investigated. (auth)

12026 (IA-704) GRAIN REFINEMENT OF URANIUM. A Literature Survey. A. J. Jacobs (Israel. Atomic Energy Commission, Tel-Aviv). Dec. 1961. 66p.

A survey on grain refinement of U is presented. A recrystallization treatment is the most effective method in the case of unalloyed U, but this treatment has the disadvantage that prior texture is not removed. If a small alloying addition is made to the U, then a transformation ($\beta \rightarrow \alpha$ or $\gamma \rightarrow \alpha$) heat treatment will produce more or less refinement depending on the degree to which the high-temperature phase (β or γ) is stablized by the alloying element. It is possible to obtain a nearly random structure, in addition to excellent refinement, by transforming a suitable dilute alloy. The effects that various dilute additions have on the transformation temperatures of U are summarized. A discussion of the variables involved in the transformation heat treatments, e.g., temperature, time, and heating rate, reveals the controversial nature regarding their roles in the grain refinement of U. Among the methods used to measure grain size in U, only a macrotechnique avoids the problem posed by subgrains. Fortunately a macrograin size was found to correlate satisfactorily with the in-pile characteristics of U. (auth)

12027 (NP-11373) MANUFACTURE OF Ti–7Al–12Zr SHEET. Final Report. (Reactive Metals, Inc., Niles, Ohio). Jan. 1962. Contract NOa(s)-59-6229-c. 63p.

The processing and properties of Ti–7Al–12Zr sheet are detailed. Laboratory research supplementary to the production is also described. (auth)

12028 (NP-11410) CANADIAN URANIUM RESEARCH FOUNDATION PROGRESS REPORT NO. 3. (British Columbia. Univ., Vancouver). Sept. 1961. 28p. (CURF-R-17)

Preparation methods for arsenides and phosphides were investigated, and research on a method of making uncontaminated nitride is reported. Attempts to explosively compact UO_2 were unsuccessful. Work is summarized on measurement of thermoelectric power and thermal conductivity of semiconductor compounds. (J.R.D.)

12029 (ORNL-3233) RELATIONSHIP BETWEEN CALCINING TEMPERATURE AND PARTICLE DENSITY OF THORIA SLURRIES. D. M. Eissenberg (Oak Ridge National Lab., Tenn.). Mar. 21, 1962. Contract W-7405-eng-26. 16p.

The variation in rheological behavior and other physical properties of thoria slurries with the calcining temperature of the thoria powder is explained on the basis of the relation between the calcining temperature and the bulk density of the individual thoria particles. Indirect experimental measurements of the bulk particle density by viscosimetry and by measurement of centrifuged-bed densities agreed with each other and fell within the predicted density limits of 3.7 g/cc and 9.7 g/cc (for oxalate-precipitated thoria). Nitrogen adsorption porosimetry of one sample was consistent with the bulk-density measurement. (auth)

12030 (SCNC-336) HIGH TEMPERATURE OXIDATION RESISTANT COATINGS FOR TANTALUM BASE ALLOYS. First Quarterly Progress Report, November 1, 1961–January 31, 1962. (Sylvania Electric Products, Inc., Sylcor Div., Bayside, N. Y.). Contract AF33(657)-7339. 48p.

The protective Sn–Al system was investigated in the 15 to 50 wt % Al range in attempts to optimize coating composition for refractory metals. Furnace test weight gains were used to study coating on Ta, Ta–10 W, Ta–10 Hf–5W, Cb, Mo, and W at 2000 and 2500°F and on Ta–10 W at 2800°F. Further studies were performed at 3000°F using oxyacetylene torch and resistance heating techniques. Significant effects were related to coating composition, coating thickness, and sample size and geometry. Modification in coating additives gave promising improvements in coating practicality and oxidation resistance. Attempts were made to develop a similar diluent system for beryllide coatings. Poor results were obtained with Sn, Cu, and Si but the Ag-Be system looked promising. (auth)

12031 (SCR-307) COATINGS FOR URANIUM. Final Report, March 1, 1959–July 1, 1960. Dwight E. Couch and Albert M. Brown (National Bureau of Standards, Washington, D. C.). Dec. 1961. For Sandia Corp. Livermore Lab., Livermore, Calif. Contract [AT(29-1)-789]. 37p.

Coatings for the corrosion protection of uranium were studied. The investigation was chiefly concerned with electrodeposited coatings, the adhesion of these coatings to uranium metal, and the black film that forms beneath the coating. Cleaning methods, x-ray and electron diffraction, sealed tube experiments, adhesion tests, preparation of uranium from plating, electrodeposited coatings from nonaqueous solutions, chemical displacement coatings, hot dipped coatings, evaporated zinc coatings, and porosity tests are discussed. It was determined that the black film that develops between uranium metal and its electrodeposited coating is a result of an adsorbed film of moisture on the uranium surface and does not result from porosity of the electrodeposit. (M.C.G.)

12032 (TID-15068) REVIEW OF INTERNAL FRICTION DUE TO POINT DEFECTS. B. S. Berry (International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.). Aug. 7, 1961. Contract [AT(30-1)-281]. 31p. (RC-509)

Simple considerations lead to the expectation that point defects will cause internal friction (by a stress-induced ordering mechanism) in all cases where the introduction of the defects sets up asymmetric distortions of the surrounding lattice. Three categories of specific examples are considered, in which the relaxation centers are believed to contain a single isolated elementary point defect, two interacting elementary point defects, and several interacting elementary point defects. The elementary point defects considered are an interstitial solute atom, a substitutional solute atom, a vacancy, and a split self-interstitial. The material for this review is taken from the existing literature with the exception of a brief account of some recent experiments on cold-worked nickel, which relate to the report of a peak due to split interstitials in this metal by Seeger, Schiller, and Kronmüller. Due to a background recovery phenomenon, it was not found possible to obtain support for the existence of the peak. (auth)

12033 (TID-15137) THE DRIVING FORCE FOR SHRINKAGE IN COPPER POWDER COMPACTS DURING THE EARLY STAGES OF SINTERING. F. V. Lenel, H. H. Hausner, I. A. El Shanshoury, and G. S. Ansell (Rensselaer Polytechnic Inst., Troy, N. Y.). [1961]. Contract [AT(30-1)-2408]. 19p.

The shrinkage behavior, of compacts from irregular Cu powder, during the initial stages of sintering was determined by a dilatometer method. The effects of compacting pressure and of external load during sintering at a constant heating rate of 3°C/min upon shrinkage were observed. The residual stresses present on the surface of compacts heated at the same rate to 200, 300, 400, 500, and 600°C were also measured. It was observed that shrinkage starts at temperatures where considerable residual stresses in the surface of the compacts are still present, and that this temperature also depends upon the external stress applied during sintering. Residual and externally applied stresses complement each other in shifting the temperature of beginning shrinkage to lower values with increasing stress. It is concluded that, in the low temperature range up to 400°C, residual and externally applied stresses rather than surface tension forces cause shrinkage. (auth)

12034 (TID-15206) A THEORY FOR THE EFFECT OF PLASTIC DEFORMATION ON ELASTIC BEHAVIOR OF A MODEL SOLID. Technical Report No. 15. T. S. Wu and C. C. Hsiao (Minnesota. Univ., Minneapolis. Inst. of Tech.). Apr. 1961. Contract AT(11-1)-532. 58p.

The theory of elasticity is applied to study the effect of homogeneous plastic deformation on the elastic behavior of a simple model solid. Supposing that the model solid is composed of a system of properly arranged linear spring elements, then the relations of the elastic constants between the oriented state, both uniaxially and biaxially, and the unoriented or undeformed state are analyzed. With the help of the deformation and orientation relationship, the variation of the elastic properties are expressed as a function of the extent of plastic deformation. The theory is derived in a fairly general manner so that it may be applicable to a certain variety of solids. Experimental data are found to agree fairly well with the theoretical result obtained. (auth)

12035 (NP-tr-864) PREPARATION OF THORIUM OXIDE MICROSPHERES. I. PRODUCTION OF SPHERICAL THORIUM HYDROXIDE PARTICLES. Yasaburo Yamazaki, Kenzo Yoshida, and Matsuo Komori. Translated by E. H. M. Colegrave (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Nippon Genshiryoku Gakkaishi, 3: 360-4(1961). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 23852.

12036 DETECTION OF LOSSES IN PRODUCTION OF THE VALUABLE ELEMENT RHENIUM. AN EXAMPLE FOR THE APPLICATION OF RADIOISOTOPES IN METALLURGY. Gunter Graf. Freiberger Forschungsh., B, No. 60, 31-46(1961).

The production of Re from Pb–Zn flue dust is investigated during individual processing steps using the radioactive isotopes Re^{186} and Re^{188}. The steps investigated include: leaching of filter oxides, thickening by evaporation, removal of Cd by cementation, precipitation of Re as sulfide, and roasting of sulfide to determine metal losses during production. (Rev. Metal Lit. 18: No. 9)

12037 REDUCTION OF NIOBIUM OXIDES BY CARBON. N. P. Sazhin, O. P. Kolchin, and N. V. Sumarokova. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 6, 8-24(Nov.-Dec. 1961). (In Russian)

Chemical and physico-chemical processes in the high-temperature reduction of niobium oxide by carbon were studied in a two-step reduction of 0.15-mm niobium pentoxide powder (with 0.01% TiO, 0.06% Fe_2O_3, and 0.01% SiO_2) at 1600 to 2000°C. The reduction of Nb_2O_5 to NbO_2 and to NbO is achieved in a relatively low vacuum or in low hydrogen or inert gas currents. The reduction to metal at these temperatures requires a higher vacuum. (R.V.J.)

12038 EFFECTS OF CYCLIC TEMPERATURE CHANGES ON TiC SINTERING. G. A. Meerson, S. S. Kiparisov, and Shao-lien Ch'ên. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 6, 52-5 (Nov.-Dec. 1961). (In Russian)

The feasibility of increasing the density of sintered titanium carbide by cyclic, short-period temperature variations and by a maximum approach to the melting point was studied. The achieved density is close to that obtained by extrusion. (R.V.J.)

12039 VACUUM REDUCTION OF α-Nb_2O_5 AT LOW TEMPERATURES. R. W. Makkay and M. E. Fine (Northwestern Univ., Evanston, Ill.). J. Appl. Phys., 33: 745 (Feb. 1962).

Electrical conductivity and internal friction characteristics of α-Nb_2O_5 were altered by vacuum annealing at 125 and 2000°C. Changes in the semiconductor defects during annealing are described. Data are presented in graphical form. (L.N.N.)

12040 OBTAINING ELECTROLYTIC TANTALUM, NIOBIUM AND THEIR ALLOYS (COMMUNICATION 2). V. I. Konstantinov, V. M. Amosov, and E. A. Kholobes (Moscow Electric Bulb Factory). Poroshkovaya Met., No. 5, 42-52(Sept.-Oct. 1961). (In Russian)

An industrial process was developed for obtaining electrolytic Ta, Nb and their alloys. Various types of electrolyzer design were tested. The optimal design proved to be a crucible cathode and a hollow graphite rod as anode. A process was developed for purifying the cathode precipitate of electrolytic Ta, Nb and their alloys by smelting in an argon atmosphere and evaporating the residues in vacuum, subsequently returning the electrolyte to the process. (auth)

12041 CARBOTHERMAL METHOD OF PRODUCING BORON CARBIDE IN RESISTANCE FURNACES. A. I. Rekov and G. V. Samsonov. Poroshkovaya Met., No. 5, 80-91(Sept.-Oct. 1961). (In Russian)

A comparison of the arc melting and carbothermal reduction methods shows technological and economic advantages in the coreless method of producing boron car-

bide powder. A description of the principle of the coreless method is given, including the subsequent treatment of the powders — removing free carbon and hydroclassification. Some proposals are advanced for the improvement of the technology of boron carbide production. (auth)

12042 RADIOISOTOPES IN PRODUCTION ENGINEERING. W. G. Busbridge. Production Engineer, 40: 468-73 (July 1961).

Applications are described which include determination of wear rate of neutron-irradiated steel piston ring; gaging thickness of sheet steel and brass with radiation; detection of flaws in steel, Fe, and Al castings by radiography using Co^{60} or Tm^{170} as gamma source. (Rev. Metal Lit. 18: No. 9)

12043 REFRACTORIES, RADIOISOTOPES AND NONMETALLIC INCLUSIONS IN STEEL. Refrattari, No. 11, 367-9(Apr. 1961).

Tracer techniques used in tracing nonmetallic inclusions in steel by treating refractories with radioisotopes are described. The radioisotopes in steel are identified by a Geiger counter, spectrometer, or film which localizes the radioactive inclusion. (Rev. Metal Lit. 18: No. 9)

12044 BERYLLIUM: A PROBLEM METAL. H. M. Finniston (C. A. Parsons & Co. Ltd., Newcastle-upon-Tyne, Eng.). Research (London), 15: 109-18(Mar. 1962).

The industrial status of beryllium in respect of extraction from its ores, its fabrication into articles for engineering use, and the properties of the commercial metal, are described. The major problems which block greater use of the metal are its price, ductility in certain ranges of temperature and perhaps high temperature irradiation effects due to nuclear reactions. These and other problems of the metal are detailed and the influence of metallurgical factors leading to control and improvements in properties of the metal are discussed. (auth)

12045 ON TECHNOLOGY OF HIGH-MELTING METALS. Technica, 10: 769-71(June 9, 1961).

A review is given of physical, mechanical, and chemical properties at room and elevated temperatures for high-melting point metals. The special processing methods including working and annealing under argon atmosphere and electron beam melting and welding are also given. The development of heat resistant Nb–W–Ta alloys is outlined. (Rev. Metal Lit. 18: No. 9)

12046 SOME PRACTICAL EXAMPLES OF THE USE OF VACUUM IN NONFERROUS METALLURGY. B. Tougarinoff. Vacuum, 10: 466-73(Dec. 1960).

Vacuum techniques employed in the dezincification of Pb; remelting of U; degassing, sintering, and fusion of Nb and Ta; and purification of Si and Ge are illustrated. (Rev. Metal Lit. 18: No. 9)

12047 A METHOD FOR PREPARING A SUPERCONDUCTING COMPOUND Nb_3Sn. F. K. Lange (Deutsche Akademie der Wissenschaften, Dresden). Zhur. Eksptl'. i Teoret. Fiz., 42: 42-3(Jan. 1962). (In Russian)

A method for preparing Nb_3Sn is described. The critical temperature of the samples is 17.85°K and the transition interval is approximately 10^{-2}°K. (auth)

12048 PROCESS FOR THE PREPARATION OF MAGNESIUM–THORIUM ALLOY. John N. Reding, Jr. (to Dow Chemical Co.). U. S. Patent 3,026,196. Mar. 20, 1962.

A method for preparing Mg–Th alloy by reduction of ThF_4 with Mg is outlined which gives good reduction efficiency, does not entrap the formed alloy in the saline phase, and prevents loss of ThF_4 by conversion into oxide. The method comprises forming a saline mixture of ThF_4, LiF, and MgF_2 and/or CaF_2 and subjecting the mixture to reduction by molten Mg at 700 to 1000°C. (D.L.C.)

Corrosion

Refer also to abstracts 12664 and 12694

12049 (AAEC/E-83) STUDY OF THE VARIABLES AFFECTING THE CORROSION OF BERYLLIUM IN CARBON DIOXIDE. A. Draycott, F. D. Nicholson, G. H. Price, and W. I. Stuart (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Dec. 1961. 34p.

The effects of the following variables on the corrosion of Be by CO_2 were studied: surface preparation of the specimen; temperature (100 to 725°C); pressure (0 to 280 psig); velocity; and impurity content of the gas. The results were statistically analyzed and kinetic data obtained. In all cases specimens with etched surfaces yielded approximately 25 to 30 percent greater weight gains than specimens with ground or polished surfaces. On extruded material no "breakaway" oxidation was encountered below 650°C in commercially dry gas (<20 ppm moisture). The rate of attack was to some extent affected by the pressure of the gas. A basic study of the chemistry of the reaction was made, as well as a detailed investigation into the variations caused by differences in the composition and fabrication of the metal. Extruded material made from beryllium powder oxidized in dry oxygen for a short time had greatly enhanced oxidation resistance when exposed to carbon dioxide. Some of the material exposed to wet carbon dioxide at 700°C and atmospheric pressure did not exhibit "breakaway" oxidation. The weight gains after 1000 hours exposure under these conditions were never greater than 0.5 mg/cm^2. Some comparisons were made between the reaction rates of beryllium with oxygen and carbon dioxide. In certain circumstances dry oxygen gave breakaway oxidation whereas carbon dioxide did not. (auth)

12050 (HW-71771) CORROSION TESTS ON KER-1 ZIRCALOY-2 PROCESS TUBE. H. P. Maffei (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1961. Contract AT(45-1)-1350. 22p.

The high temperature water and steam autoclaving tests performed on various pieces of the KER-1 Zircaloy-2 process tube showed that the surface of the tube was corrosion prone. This surface condition appeared to be caused by contamination or a localized surface condition related to fabrication history. The possibility that the localized heavy corrosion was due to overheating during reactor exposure is remote. Metallographic evidence on distribution of hydriding and oxide thickness in the high corrosion zone do not support this theory. (auth)

12051 (NAA-SR-6493) OXIDATION KINETICS OF $ZrBe_{13}$ AND $NbBe_{12}$. G. Ervin, Jr., and M. M. Nakata (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 15, 1962. Contract AT (11-1)-GEN-8. 32p.

Oxidation rates of the intermetallic compounds $ZrBe_{13}$ and $NbBe_{12}$ between 700 and 1500°C were measured in oxygen by a volumetric method, using granular metal samples of known surface areas determined by a gas adsorption method. Oxidation of $ZrBe_{13}$ between 900 and 1500°C produced a BeO layer, and the thickening of the oxide layer with time followed the parabolic law, showing activation energies similar to those for beryllium metal oxidation. At 600 to 700°C, $ZrBe_{13}$ oxidized at an accelerating rate

accompanied by disintegration of the metal phase; this behavior was similar to beryllium metal oxidation at 700 to 750°C. $NbBe_{12}$ did not show disintegrative oxidation but showed other complexities. The relation of the parabolic oxidation constants to self-diffusion and to the defect structure of BeO is discussed. A tentative conclusion is that transport through the BeO layer depends chiefly on the formation of Be^{+2} vacancies at the oxide-oxygen interface. (auth)

12052 (AEC-tr-5006) APPLICATION OF A METHOD OF POLARIZATION WITH INTERMITTENT CURRENT TO THE STUDY OF THE CORROSION PROCESSES IN MEDIA OF HIGH OHMIC RESISTANCE. Yu. N. Mikhailovskii and N. D. Tomashov. Translated by Lydia Venters (Argonne National Lab., Ill.) from Trudy Inst. Fiz. Khim., Akad. Nauk S.S.S.R., No. 7, 85-95(1959). 14p.

A method for studying electrochemical corrosion utilizing intermittent-current polarization is described. Equivalent electric circuits representing the electrochemical system are discussed. An outline is given of an apparatus for investigating the electrochemical processes in high-resistivity media or in the presence of insulator-coated electrodes. The electrochemical processes on Fe in a soil with variable moisture content and on bitumen-insulator-coated Fe electrodes are determined. (T.F.H.)

12053 (AEC-tr-5007) APPLICATION OF AN OHMIC CAPACITATIVE METHOD FOR THE STUDY OF THE BEHAVIOR OF PROTECTIVE FILMS DURING CORROSION OF METALS IN THE STRESSED CONDITION. N. D. Tomashov and N. I. Isaev. Translated by Lydia Venters (Argonne National Lab., Ill.) from Trudy Inst. Fiz. Khim., Akad. Nauk S.S.S.R., No. 7, 78-84(1959). 9p.

The behavior of protective films on the surfaces of metals subjected to stresses in corrosive media is studied by means of simultaneous measurements of the resistance and capacitance of the film. The corrosion of Al with various oxide films is studied in H_2SO_4 and NaOH. (T.F.H.)

12054 (AEC-tr-5009) METHOD OF DETERMINATION OF THE RATE OF CORROSION PROCESSES UNDER THIN FILMS OF ELECTROLYTE. N. D. Tomashov and G. K. Berukshtis. Translated by Lydia Venters (Argonne National Lab., Ill.) from Trudy Inst. Fiz. Khim., Akad. Nauk S.S.S.R., No. 7, 5-10(1959). 9p.

The effects of several external factors on the rates of corrosion processes in metals under a film of humidity (either a visible or an adsorbed film) are studied using a microcorrosion battery as a model of the actual metal surface. Effects considered include temperature, atmospheric humidity, composition of the electrolytic film on the surface, and the mixing intensity of the film. (T.F.H.)

12055 EXPERIMENTS ON CORROSION BY HOT WATER. Enrico Chiostri. Corrosion et anti-corrosion, 8: 15-36(Jan. 1960). (In French)

Tests are performed on various types of piping materials, in order to evaluate their resistance to electrochemical corrosion by hot water. Measurements are made by classical as well as modern methods, and conclusions are reached concerning metallic and plastic piping materials. On the basis of the composition of the water, the results may be extended to the effects of naturally saline water (such as sea water). (tr-auth)

12056 FACTORS INFLUENCING STRESS CORROSION OF REACTOR MATERIALS. W. E. Tragert (General Electric Research Lab., Schenectady, N. Y.). Corrosion et anti-corrosion, 8: 196-201(May 1960). (In French)

An explanation is sought for the formation of fissures in metals and alloys by stress corrosion, in the light of a number of hypotheses. These hypotheses are classed into electrochemical mechanisms, electrochemical-mechanical mechanisms, and mechanisms involving fissuring by absorption of constraints. In the case of corrosion of U alloys, the extents to which the various hypotheses are able to explain the observed phenomena are discussed. (tr-auth)

12057 STAINLESS STEELS AND HIGHLY ALLOYED STAINLESS ALLOYS. J. Bourrat (Compagnie des Ateliers et Forges de la Loire, France). Corrosion et anti-corrosion, 8: 293-302(Sept. 1960). (In French)

The principal types of corrosion-resistant stainless steels (SS) and special Ni-base alloys used in the chemical industry are reviewed. These include austenitic steel alloyed with Mo, austenitic-ferritic steel, highly alloyed austenitic steel and Ni-base alloys. The Ni-base alloys are of interest because of their high-temperature corrosion resistance in concentrated sulfuric and hydrochloric media. (tr-auth)

12058 INTERNAL CORROSION AND CORROSION PROTECTION OF GAS PIPES. J. Morlet. Corrosion et anti-corrosion, 8: 303-18(Sept. 1960). (In French)

Studies are reported of atmospheric corrosion of pipes, after storage of the pipes and submission of the pipes to hydraulic testing; of corrosion caused by O_2 in the transport of refined coal gas, and by H_2S in the transport of unrefined coal gas; and of the corrosive effects of carbonic gas, water vapor, and pressure. Means are indicated for corrosion protection, including dehydration of the gas, or in cases in which this is not possible, the use of various coatings or inhibitors. (tr-auth)

12059 THE MECHANISM OF VANADIUM PENTOXIDE EFFECTS ON THE CORROSION RATE OF EI-417 STEEL. D. V. Ignatov and E. A. Kovalev. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 6, 107-14 (Nov.-Dec. 1961). (In Russian)

The mechanism of V_2O_5 and $V_2O_5 + Na_2SO_4$ accelerated corrosion of chromium-nickel-austenite steel (with wt % of C = 0.11, Mn = 1.24, Si = 0.76, Cr = 24.1, Ni = 18.47, P = 0.022, and S = 0.013) was studied at 600 to 850°C. (R.V.J.)

12060 OXIDATION OF BERYLLIUM IN CARBON DIOXIDE AND OXYGEN. J. K. Higgins and J. E. Antill (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 5: 67-80(Jan. 1962). (In English)

Weight gain/time curves were obtained for samples of beryllium sheet fabricated by a variety of different routes, in dry carbon dioxide at 500 to 1000°C, in oxygen at 600 to 1000°C and in carbon dioxide containing water vapor at 700°C for times up to 10000 h. Protective films were formed on most materials in dry carbon dioxide at 1 atm pressure and temperatures up to 850°C. At 1000°C breakaway was obtained after 1500 hr. The presence of 3 vol % water vapor in carbon dioxide at 1 atm resulted in breakaway at 700°C. The subsequent linear rates of attack were markedly dependent upon the method used to fabricate the metal and differed by as much as a factor of 1000 in certain instances. Most of the differences in the behavior of materials could not be related to impurity content but were consistent with the view that protection is associated with an intergranular network of oxide in certain batches of metal. No significant protection from breakaway in wet gas was provided by oxide films previously grown on the fabricated samples in dry carbon dioxide. The behavior of metal in dry oxygen also varied with the method of fabrication. In some cases it was very similar to that in dry

carbon dioxide, while in others breakaway was obtained at 700 and 850°C. (auth)

12061 STUDIES ON CORROSION OF ALUMINUM ALLOY FOR WATER COOLED REACTOR. DYNAMIC CORROSION TEST OF ALUMINUM IN HIGH-PURITY WATER BETWEEN 50-80°C. Light Metals, 11: 131-48(Mar. 1961).

Determination of corrosion rates, oxide film thickness, weight loss, and corrosion microstructures for 2S Al and 1% Ni–Al alloys as a function of time, temperature, and flow rate for exposure in high-purity water at 3 to 14 m per sec flow for times of 214 hr to 1 yr at 50 to 80°C are made. (Rev. Metal Lit. 18: No. 9)

12062 EFFECTS OF THERMAL TREATMENT ON CORROSION OF TITANIUM ALLOY VTZ-1 IN SULFURIC ACID. I. S. Anitov and B. D. Kukalenko. Zhur. Priklad. Khim., 34: 2466-72(Nov. 1961). (In Russian)

The corrosion resistance of titanium alloy VTZ-1 (6% Al, 3% Mo, and 3% Cr) in 72% sulfuric acid is less than in 25% solution due to the reduced passivity period. Thermal treatment does not influence the rate of corrosion. (R.V.J.)

12063 ZIRCONIUM CORROSION IN DISTILLED WATER AT 85°. V. V. Gerasimov, A. I. Gromova, and E. T. Shapovalov. Zhur. Priklad. Khim., 34: 2473-7(Nov. 1961). (In Russian)

Zr corrosion in distilled water (pH = 6.5, SO_4 = 0.6 mg/l) at 85°C in contact with 1 × 18H9T steel (0.12% C, 0.50% Si, 1.30% Mn, 18.13% Cr, 9.8% Ni, and 0.55% Ti) and with aluminum A1M (0.22 Fe, 0.06 Si, and <0.01 Cu) at a surface ratio of 1 : 1 was investigated. The contact of zirconium with stainless steel or aluminum does not change the kinetics of the corrosion process but increases the rate of corrosion. A 0.1 mm space between the materials does not alter the corrosion behavior. The high corrosion resistance exhibited by Zr in distilled water at 85°C is a result of passivity. (R.V.J.)

12064 ELECTROCHEMICAL PASSIVATION OF Zr IN ACID SOLUTIONS. A. Ya. Shatalov and T. P. Bondareva. Zhur. Priklad. Khim., 34: 2487-95(Nov. 1961). (In Russian)

Following the initial fast use of the potential, a constant potential that did not vary with current density but did vary somewhat with HCl concentration was observed in anodic polarization of Zr in HCl. A continuous potential rise that reached dozens of volts was observed in anodic polarization of Zr in H_2SO_4 solution at 20 to 266 $\mu a/cm^2$. Regular zirconium anode volume reduction and transitional resistance increase were observed simultaneously with the potential changes. (R.V.J.)

Fabrication

12065 (AMC-TR-7-775(V)) COLUMBIUM AND COLUMBIUM ALLOY EXTRUSION PROGRAM. PHASE IV: DEVELOPMENT OF THE EXTRUSION OPERATION AND POST-EXTRUSION CONDITIONING. Interim Report V, October 16, 1961–January 16, 1962. J. S. Clark (Du Pont de Nemours (E. I.) & Co. Pigments Dept., Wilmington, Del.). Jan. 16, 1962. Contract AF33(600)-40700. 65p.

The extrusion and post-extrusion conditioning of D-31 Nb alloy "T" extrusions are described. The results of mechanical tests and metallographical inspections are reported. (auth)

12066 (ASD-TR-7-785(IV)) MOLYBDENUM ALLOY EXTRUSION DEVELOPMENT PROGRAM. Fourth Interim Technical Engineering Report, August 15, 1961–December 15, 1961. P. A. Santoli (Allegheny Ludlum Steel Corp. Research Center, Brackenridge, Penna.). Jan. 1962. Contract AF 33(600)-40861. 97p.

The extrudability of hot-work forged TZM was evaluated by the extrusion of solid rounds at a reduction ratio of 18:1 at 2300 to 2700°F. The extrusions were characterized primarily by poor surface quality and by little change in hardness from that of the original billet. T shaped extrusion dies were coated with zirconia by plasma-arc spraying at seven different sources. T shaped extrusions of TZM generally exhibited an increase in hardness from that of the original billet except in mid-extrusion. (auth)

12067 (ASD-TR-7-785(V)) MOLYBDENUM ALLOY EXTRUSION DEVELOPMENT PROGRAM. Interim Technical Engineering Report No. 5, December 15, 1961–February 15, 1962. P. A. Santoli (Allegheny Ludlum Steel Corp. Research Center, Brackenridge, Penna.). Feb. 1962. Contract AF33(600)-40861. 31p.

Seven "T"-shape extrusions of TZM were made at 3200°F in the evaluation of various die coating sources. Two "T"-shape extrusions were made at 3200°F to study the effect of high-temperature solutioning treatments on the extrudability of TZM. Severe die wash occurred during these extrusions, resulting in poor surface quality. However, coarse macrostructure observed in the billet material is believed to be partially related to this poor surface quality. (auth)

12068 (CNLM-3342) SPINNING OF COLUMBIUM AND COLUMBIUM 1%-ZIRCONIUM TUBING. Interim Report. Wharton R. Barker (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Jan. 19, 1961. Contract [AT(11-1)-229]. 8p.

Spinning data are presented for spinning Nb and Nb–1% Zr thin-wall tubing from ingot, forged, or welded tube blanks. Mechanical properties of typical Nb–1% Zr spun tubing are compared with these for extruded and cold-worked (20%) tubing. Dimensional and tolerance limits are given. (D.L.C.)

12069 (FD-72) FABRICATION OF SOLID PELLET UO_2 RODS FOR NRX. J. S. Nelles (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 12p.

For presentation at the Fourteenth Joint U.S.-Canadian Sheath Program Meeting, Savannah River Plant, Nov. 7 and 8, 1961.

Solid-pellet UO_2 rods are being irradiated in the outer low-flux positions of NRX. These rods are ten feet long, so techniques were developed to produce close tolerances on the long sheaths. Aluminum alloy sheaths are used to improve the structural strength of the rod and to contain the pressure of released fission-product gases. Attention is given to the design of the end plugs so that welding problems are reduced. Inspection tests are developed for the rod and its components. (auth)

12070 (FD-76) THE FABRICATION OF NRX CORES. G. C. Wootton (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 23p.

For presentation at the Fourteenth Joint U.S.-Canadian Sheath Program Meeting, Savannah River Plant, Nov. 7 and 8, 1961.

The rolling of metallic uranium bars for the NRX reactor is described. A comparison between two runs is made on the basis of starting material, roll-pass design, surface quality of finished bars, and heat treatment used. The results of beta-heat-treatment tests, using a special thermocouple bar, are reported. The use of an ultrasonic test for the completeness of beta transformation is reported,

and metallographic evidence of its effectiveness is given. (auth)

12071 (HW-67679) HIGH FREQUENCY RESISTANCE WELDING OF SPACER RIBS TO ZIRCALOY-2-CLAD UO_2 FUEL COMPONENTS. L. R. Vancott (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1961. Contract AT(45-1)-1350. 34p.

A high-frequency resistance-welding process was developed for continuous welding of spacer ribs to 8-foot lengths of Zircaloy-2 fuel cladding. Studies in the past year demonstrated that such welding is practical and structurally sound. Welds between the ribs and fuel cladding have high strength, adequate corrosion resistance, and the ribbed cladding is within specified dimensional limits. The process was adapted to 19-rod cluster and nested tubular fuel elements for the PRTR. (auth)

12072 (NYO-10006) ULTRASONIC EXTRUSION; REDUCTION IN VEHICLE AND PLASTICIZER REQUIREMENTS FOR NON-CLAY CERAMICS. William B. Tarpley, Kenneth H. Yocom, Richard Pheasant (Aeroprojects, Inc., West Chester, Penna.). Nov. 1961. Contract AT(30-1)-1836. 66p.

Work on the ultrasonic extrusion of lead and aluminum has been extended to the cold extrusion of plasticized ceramic compositions, resulting in significant improvements in increased extrusion rate, decreased extrusion pressure, and in extruded specimen properties. It has also been found possible to extrude materials which are normally nonextrudable because of their low plasticizer or water content. Fused, ground alumina could be ultrasonically extruded with 15% less water than the minimum content without ultrasonics, and only 40 to 60% of that used in normal commercial practice. Significant improvement in the strength of as-extruded shapes, as well as reduced shrinkage and deformation in drying and firing, resulted. Compositions normally using 3 wt.% ammonium alginate as a plasticizer can be extruded with 0.2 wt.% plasticizer when ultrasonically activated. It has been postulated that the ultrasonic effects observed are derived from reduction of surface friction, shear thinning of the thixotropic systems, particle orientation, surface-film rupture, and wetting phenomena. As-extruded specimen improvement was evidenced by a smoother surface and freedom from cracks, tearing, and peeling. When steel dies were used, abrasion of the die surface sometimes caused a superficially discolored surface in nonultrasonic extrusions. The comparable ultrasonic extrusions showed little or no discoloration as the ultrasonic power level was increased. Ultrasonically extruded specimens which were fired in the same kiln loading as their corresponding controls show small but consistent increases in fired density. Water absorption was approximately 75% of the control. The highest moduli of rupture in the fired specimens were found in the ultrasonic specimens even though these required only 25% of the extrusion pressure of the controls. Ultrasonic extrusion of plasticized powders appears to be generally applicable to the wide range of powders and plasticizers studied. These include submicron zirconia, 100-μ tabular alumina, fused alumina, nonsintered alumina, Ajax P clay, chemically reactive magnesia, porcelain, and titania. The compositions were plasticized with alginates, starch-glycerin, and several polymers. (auth)

12073 (FTD-TT-61-459) A RIBBED TUBE FOR HEAT EXCHANGERS AND A METHOD OF ITS FABRICATION. D. I. Zaslavskii (Zaslavskiy). Translated from U.S.S.R. Patent No. 128,030. June 6, 1957. 4p.

A method for fabricating a ribbed tube comprises laying wire spirals in parallel rows along the generatrix of the outside surface of the tube. A device is described for laying the spirals and welding them to the tube. The advantages of the method are that it may be used with noncircular tubes and that the resulting heat exchange surface may be cleaned easily by steam or air blasting. (D.L.C.)

12074 THE MANUFACTURE OF CONTROL RODS IN THE ASEA NUCLEAR POWER DEPARTMENT. Brian Mills (Allmänna Svenska Elektriska Aktiebolaget, Västeras). ASEA Journal, 34: 222-3(1961). (In English)

The method by which control rods were manufactured for the Agesta pressurized water reactor in Sweden and the Halden boiling water reactor in Norway is described. For physical and metallurgical reasons, an alloy of silver together with 15% indium and 5% cadmium was selected for the Agesta reactor and an alloy of silver with 30% cadmium for the Halden reactor. Because of mechanical strength deficiencies, the neutron absorbing silver alloys were clad with stainless steel. The cladding of the Agesta rods was metallurgically bonded to the neutron absorbing silver alloy. As a preliminary stage to bonding, those surfaces of the stainless steel cladding tubes which were to come into contact with the silver alloy were activated and then consecutively nickel and copper plated. The steel tubes for the Halden control rods were thoroughly cleaned by degreasing and pickling before compound drawing. (P.C.H.)

12075 FORGING URANIUM. P. I. Seredin. Kuznechno-Shtampovochnoe Proizvodstvo, 14-18(Jan. 1961).

Preparation of alpha uranium ingots and slabs for forging and rolling operations, heating and deformation technology, and protection of forgings against oxidation are described. (Rev. Metal Lit. 18: No. 9)

12076 VISCOUS FLOW IN SINTERING OF ZIRCONIUM BORIDE BY HOT PRESSING. M. S. Koval'chenko and G. V. Samsonov (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., No. 5, 3-9(Sept.-Oct. 1961). (In Russian)

Equations were derived for describing densification in sintering powders by hot pressing, sintering under pressure, and ordinary sintering without outside pressure. Values were determined for the shear viscosity coefficients of compact ZrB_2 at sintering temperatures and for the energy of lattice disintegration. (auth)

12077 PREPARATION OF THIN Al_2O_3 FOILS. G. B. Andreev, A. S. Deineko, I. Ya. Malakhov, P. V. Sorokin, A. Ya. Taranov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Pribory i Tekh. Ekspt., 6: No. 6, 149-50(Nov.-Dec. 1961). (In Russian)

The preparation of less than 0.1 μ-thick Al_2O_3 foils by evaporation in a vacuum is described. Impurities do not exceed 0.5%. (R.V.J.)

12078 USE OF RADIOACTIVE TRACERS IN THE INVESTIGATION OF DRAWING DIE WEAR. P. F. Groshev. Tsvetnye Metally, 34: 71-5(Mar. 1961).

Copper wire is drawn through a radioactive drawing die to study the distribution of wear products on the wire surface and within the lubricant. Drawing die wear is determined as a function of drawing speed. (Rev. Metal Lit. 18: No. 9)

Properties and Structure

Refer also to abstracts 12665, 12695, 12696, and 12697

12079 (61-RL-2745M) MECHANISMS OF DEFORMATION AND FRACTURE IN PYROLYTIC GRAPHITE. E. R.

Stover (General Electric Co. Research Lab., Schenectady, N. Y.). June 1961. 24p.

Mechanisms of deformation and fracture at room temperature are studied by testing deposits in flexure and compression as a function of specimen orientation. Values of Young's modulus parallel and perpendicular to the planes, flexure strength, and strength in shear across the layers are determined. Shear between layers by kinking, which may be reversible, and by fracture of a few layers and bulk sliding between them, is a significant mode of deformation; resistance to such shear may vary by more than a factor of 2 between deposits of different structure. Structural studies of specimens stressed in tension between 2500 and 3000°C also show the importance of bulk sliding and slip between layers in the plane of applied tension. Cathodic etching reveals micromechanisms of such deformation at 2620 and 2750°C. In addition, elongation in the plane of deposit occurs by rotation of crystallites to increase the preferred orientation; the contribution to plastic strain from this mechanism may be estimated from x-ray measurements. Such deformation can precede and assist the processes of ordering and crystallite growth during annealing. (auth)

12080 (AD-259795) AN INVESTIGATION OF THE CRACK-PROPAGATION RESISTANCE OF HIGH-STRENGTH ALLOYS AND HEAT-RESISTANT ALLOYS. Bimonthly Progress Report No. 3 April 23, 1961 through June 23, 1961. P. C. Jenkins and J. D. Morrison (Southern Research Inst., Birmingham, Ala.). June 27, 1961. Contract NOw 61-0392-d. 14p.

In the evaluations of the Mo sheet materials, emphasis was placed on locating brittle-ductile transition temperatures. Both the Mo + 0.5% Ti and the TZM (Mo + 0.5% Ti + 0.08% Zr) alloys had a transition temperature at 65°F. The transition temperature for unalloyed molybdenum was 150°F. In the investigation of the tensile and crack-propagation properties of the Mo alloys at elevated temperatures, no pronounced effects attributable to strain aging were found for the unalloyed Mo or the Mo—0.5% Ti alloy. However, the 0.2%-offset yield strength showed a slight maximum and the ultimate tensile strength showed a marked maximum at 1000°F for the TZM material. This was also accompanied by a corresponding drop in net fracture stress at the same temperature. These effects are believed to be definitely the result of a strain aging phenomenon. (auth)

12081 (AD-260547) AN INVESTIGATION OF THE CRACK-PROPAGATION RESISTANCE OF HIGH-STRENGTH ALLOYS AND HEAT-RESISTANT ALLOYS. Bimonthly Progress Report No. 1, December 23, 1960–February 23, 1961. J. D. Morrison (Southern Research Inst., Birmingham, Ala.). Mar. 17, 1961. 16p.

The crack-propagation characteristics of a number of heat-resistant alloys and high-strength alloys are studied at room temperature and at elevated temperatures using fatigue-cracked specimens. These alloys fall into three general groups, viz. refractory metals, super alloys, and some special "high-purity" steels. Experimental procedures suitable for these alloys are presented. An evaluation of the standard tensile properties and crack-propagation properties of aged A 286 alloy sheet is made. It is found that the net fracture stress of fatigue-cracked specimens of this alloy is intermediate between the yield strength and ultimate strength at temperatures from 75 to about 1000°F. At 1500°F, the net fracture stress of the fatigue-cracked specimens is somewhat higher than the ultimate tensile strength. (auth)

12082 (AFOSR-2041) LOW TEMPERATURE STUDY OF THE ELECTRONIC BAND STRUCTURE OF METALS AND THEIR DILUTE ALLOYS. Final Report. William L. Gordon and Thomas G. Eck (Case Inst. of Tech., Cleveland). Jan. 1962. Contract AF 49(638)-621. 49p.

Activities in an investigation of band structure in selected pure metals are reported. Techniques used in the investigation were the de Haas-Van Alphen effect in conjunction with a cyclotron resonance, and galvanomagnetic effects such as the variation with magnetic field strength of electric field components parallel and transverse to the electric current in the limit of high magnetic field. (J.R.D.)

12083 (ARF-2227-4) HIGH-TEMPERATURE OXIDATION PROTECTIVE COATINGS FOR VANADIUM-BASE ALLOYS. Bimonthly Report No. 4, December 12, 1961 to February 11, 1962. F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Mar. 7, 1962. Contract NOw 61-0806-c. 14p.

Coatings for the protection of vanadium alloys in air at 2000°F and up were investigated. Nickel, flame-sprayed on V-Nb alloys, forms an intermetallic compound and an outer glassy phase upon exposure to elevated-temperature air. Protection of V-1w/o Ti-60w/o Nb is afforded for 45 hr at 2200°F and more than 150 hr in air at 2000°F. After intentional defecting, failures are extremely slow compared to the unprotected alloy base. Siliconized V-1w/o Ti-60w/o Nb, produced in a static argon pack cementation process, is oxidation resistant for at least 800, 290, and 50 hr in static air at 2000, 2200, and 2500°F, respectively. Samples of V-5w/o Ti-20w/o Nb, coated similarly, are oxidation resistant for 456, 280, and 259 hr at 1500, 2000, and 2200°F, respectively. Coatings on the higher-Nb alloy show a capability for tolerating defects which has not been noted in the low-Nb alloy. Siliconized samples of V-1w/o Ti-60w/o Nb, deformed by bending at room temperature to a stress near the yield point, appear to be oxidation resistant when subsequently exposed to 2000°F air. (auth)

12084 (ARF-2231-2) PILOT EVALUATION OF VANADIUM ALLOYS. Bimonthly Report No. 2, November 18, 1961–January 17, 1962. B. R. Rajala and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 14, 1962. Contract NOw 62-0101-c. 10p.

The effects of interstitial impurities, especially O and N, on the fabricability and elevated-temperature strength properties of Nb-V base alloys are under investigation. To establish optimum interstitial levels, a series of alloys based on V-1 wt % Ti-60 wt % Nb and V-1 wt % Hf-60 wt % Nb were prepared as small arc-melted ingots with varying O and N additions. Analyses of V alloy sheet stock which was tensile tested under a dynamic He atmosphere indicated that good elevated-temperature strength was obtained at O and N levels in the range of 0.07 to 0.13 wt %, and the specimens exhibited room-temperature bend ductility. Tensile evaluations under vacuum at 2000°F showed the addition of 0.05 wt % O to a V-5 wt % Ti-20 wt % Nb base to be a much more potent strengthener than was 0.03 wt % C to the same base. (auth)

12085 (ARL-101) FACTORS AFFECTING THE HIGH TEMPERATURE STRENGTH OF POLYCRYSTALLINE SOLIDS. Oleg D. Sherby (Stanford Univ., Calif.). Dec. 1961. Contract AF33(616)-6789. 31p.

Quantitative analyses of the high temperature strength data (70.5Tm) on pure polycrystalline metals indicate that factors which will promote the high temperature creep resistance include crystal structure; the best structure is the diamond type, followed by the close-packed FCC or HCP and lastly, the BCC structure. Other factors are high

melting temperature, high elastic modulus, high valence state, and fine stable grain size. Comparison of current theories of high temperature deformation with experimental data reveals that Weertman's theory of creep based on dislocation climb best describes the experimental data for creep of pure metals at high stresses and the Nabarro-Herring theory based on atomic diffusion appears applicable at low stresses. The role of stable discontinuous precipitates on high temperature creep is not clearly understood, and their role on the creep strength of sintered Al powder is probably only of secondary importance. (auth)

12086 (BM-RI-5925) IRON–GADOLINIUM PHASE DIAGRAM. M. I. Copeland, M. Krug, C. E. Armantrout, and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Feb. 1961. 20p.

Data from the investigation of the iron–gadolinium phase diagram revealed a single eutectic system with very limited terminal solubility and three intermediate phases. The eutectic point occurs at about 85 percent gadolinium, and the eutectic isotherm, which occurs at 850°C, extends from the compound Fe_2Gd to 99-plus percent gadolinium. Very little solubility of the solid phases in each other was observed. The three intermediate phases, Fe_9Gd, Fe_3Gd, and Fe_2Gd, melt incongruently at peritectic isotherms at 1320, 1150, and 1080°C, respectively. The crystalline systems of the three phases were determined as follows: Fe_9Gd, hexagonal; Fe_3Gd, hexagonal or rhombohedral; and Fe_2Gd, face-centered cubic. No lowering or raising of the alpha-gamma iron transformation at 910°C, the gamma-delta iron transformation at 1388°C, or the gadolinium transformation at 1262°C was observed. The principal methods used in determining the iron–gadolinium phase diagram were melting-point determinations, thermal analyses, metallographic examination, and x-ray diffraction analyses. Melting, heat treating, and thermal analyses were conducted in a vacuum or under a helium atmosphere because of the avidity with which oxygen combines with gadolinium at elevated temperatures. A few hardness values were determined, but they had no part in the derivation of the phase diagram. No other mechanical properties were determined. (auth)

12087 (BM-RI-5933) QUALITY OF ZIRCONIUM PREPARED BY DIFFERENT REDUCTANTS. Gerald W. Elger (Bureau of Mines, Albany, Ore.). Jan. 3, 1961. 23p.

The quality of Zr metal prepared by batch reduction of $ZrCl_4$ by Na, Mg, and mixtures of Na and Mg is examined. Criteria for quality are based on chemical analyses and hardness testing of Zr arc-melted from sponge. The best quality Zr with respect to low O content and hardness numbers is prepared by reaction of $ZrCl_4$ with a mixture of Na and Mg. This reaction can be carried out by addition of Na and Mg before the initial reaction, and by periodic injection of Na during reaction of $ZrCl_4$ with Mg. The largest quantity of metal was found to be recovered from experiments in which a mixture of Na and Mg was used. Mg appeared to be a better reductant than Na in that Mg-reduced Zr contained less O and exhibited lower hardness numbers than Na-reduced metal. (auth)

12088 (CRGM-1040) CREEP OF ZIRCALOY-2 PRESSURE TUBES. 2. TRANSVERSE DIRECTION. L. G. Bell (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1962. 35p. (AECL-1456)

Creep test results are reported on transverse specimens machined from a Zircaloy-2 pressure tube for NPD-2. Two series of tests were done for extrapolation over stress and temperature. The test conditions were as follows: temperature 300°C, stresses between 20,000 and 47,500 lb/in.^{2}; and stress 20,000 lb/in.^{2}, temperatures between 300 and 500°C. The creep rates for tests at 300°C and low stresses were lower than those found previously for longitudinal specimens, but at high stresses there was an early onset of tertiary creep followed by rapid failure. The onset of tertiary creep was accompanied by elliptical necking; in tubes, because of the additional restraint opposing necking in the longitudinal direction, early necking is not expected to occur. Extrapolation of the creep rate over the temperature range appeared to be more successful than extrapolation over the stress range. A minimum creep rate of 6×10^{-8}%/h for 20,000 lb/in.^{2} at 300°C was found. (auth)

12089 (CRGM-1046) THE EFFECT OF COLD WORK ON MECHANICAL PROPERTIES AND ITS RECOVERY IN ZIRCALOY-2. L. G. Bell (Atomic Energy of Canada Ltd., Chalk River, Ont.). Oct. 1961. 21p. (AECL-1441)

The effect of various levels of cold work up to 35% in the transverse direction and up to 50% in the longitudinal direction on the tensile properties of cold-rolled plate were measured at room temperature and at 300°C. The strength at room temperature was found to be almost the same in the two directions, but at 300°C the transverse direction was weaker for all values of cold work. Room-temperature tensile tests were done on cold-worked Zircaloy-2 after prolonged annealing at 280°C and 300°C to measure the extent of recovery. It was found that a certain amount of recovery does occur at these temperatures. (auth)

12090 (EOS-1592-2M-5) HIGH TEMPERATURE SEMICONDUCTING COMPOUNDS FOR THERMOELECTRIC POWER GENERATION. Bi-Monthly Progress Report No. 5, August 15–October 15, 1961. C. B. Jordan (Electro-Optical Systems, Inc., Pasadena, Calif.). Nov. 15, 1961. Contract NObs-84327. 10p.

Synthesis of chalcogenides during the period is reported with nominal compositions MCh_2 and M_2Ch_3 (where M = U or Th, and Ch = S, Se, or Te). The Seebeck coefficient was measured as a function of temperature for all these except Th_2S_3, U_2S_3, and U_2Te_3. Electric resistivity was measured as a function of temperature for ThSe, US_2, USe_2, and UTe_2, and at room temperature for all the remaining materials except U_2S_3 and U_2Te_3. Further development of analytical methods was continued. (J.R.D.)

12091 (GA-1526) THERMAL CONDUCTIVITY OF REACTOR MATERIALS. Second Quarterly Report for the Period April 1, 1960 through June 30, 1960. M. Cutler, H. R. Snodgrass, and C. E. Mallon (General Atomic Div. General Dynamics Corp., San Diego, Calif.). July 29, 1960. Contract AT(04-3)-167. 10p.

Experimental work during the quarter was devoted to development of the pulse decay method which has proceeded to the point where the electronic apparatus is functioning and measurements were made on zirconium oxide. Other work was done on an a-c heating method which was studied experimentally to verify theoretical predictions. It was found that the emissivity of W surface is strongly sensitive to the nature and partial pressure of the gases in which the filament is heated. (J.R.D.)

12092 (GA-2848) A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS. Quarterly Progress Report for period ending December 31, 1961. T. A. Trozera, R. H. Chambers, and J. L. White (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Jan. 31, 1962. Contract AT(04-3)-167. 22p.

Activities are reported in a program to investigate activation energy and mechanisms for flow in bcc metals. Preliminary measurements were made on ultra-pure Ta crys-

tals. The activation volume was determined by strain-rate changes during tensile testing. An equation for calculation of the deformation is included. Progress in examination of deformation mechanics of refractory bcc metals via mechanical relaxation measurements is also reported. Data are included which were obtained from experiments with Ta and Mo specimens. In other work, examination of the effects of prior mechanical history on the preferred orientation of recrystallized metals is reported. A block of OFHC Cu was deformed uniaxially prior to annealing at 440°C for recrystallization. Data on the stored-energy releases in these specimens are tabulated. Work was also done on high-purity Cu to examine the relation between the effects of grain size and purity on the stored energy in the cold-worked metal. A series of experiments is in progress to test the concept of enclosing cold-worked specimens entirely in a cell which has attained stable thermal coupling with the calorimeter block through previous runs to high temperature. (J.R.D.)

12093 (HW-69305) THE SYSTEM PuO_2-ZrO_2. D. F. Carroll (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1961. Contract AT(45-1)-1350. 23p.

A study of the system PuO_2-ZrO_2 was undertaken to provide a phase diagram, the initial prerequisite to fuel evaluation. The phase equilibria were studied by x-ray diffraction and metallographic techniques. A single-phase, face-centered cubic solid solution exists up to 80 mole % ZrO_2. The region from 80 to 99.8 mole % ZrO_2 consists of two phases: monoclinic ZrO_2 and a face-centered cubic PuO_2-80 mole % ZrO_2 solid solution. The transformation temperatures of the two-phase compositions increase with ZrO_2 concentration in a curvilinear fashion and reach a maximum temperature of 1200°C at the pure component. The experimental liquidus was continuous throughout the entire composition range. An addition of 0.2 mole % PuO_2 dimensionally stabilizes monoclinic ZrO_2. (auth)

12094 (HW-70977) RESISTIVITY VARIATIONS IN ZIRCALOY-2 FOR LOW HYDROGEN CONCENTRATIONS. W. G. Magnuson, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 6, 1961. Contract AT(45-1)-1350. 5p.

Resistivity measurements were made on Zircaloy-2 samples containing hydrogen concentrations between 0 and 15,000 ppm (by weight). The resistivity increased above 500 ppm and it appears feasible that resistivity measurements could be utilized to quantitatively determine hydrogen concentrations in Zircaloy-2 above 1000 ppm. (auth)

12095 (HW-72266) EFFECT OF OXYGEN ON HYDROGEN PICKUP OF ZIRCALOYS DURING AUTOCLAVING. H. P. Maffei (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 9, 1962. Contract AT(45-1)-1350. 14p.

A study was conducted to determine whether H partial pressure existing in the static autoclaves or the higher O concentration in the refreshed autoclaves is the variable controlling factor in H pickup by Zircaloy. Resulting data indicate that Zircaloy H pickup can be reduced by operating in a refreshed autoclave system using O containing water. It appears possible to reduce H pickup in reactor systems by maintaining an O partial pressure in the coolant. (J.R.D.)

12096 (KAPL-2182) A STUDY OF THE LITHIUM–BORON–CARBON SYSTEM. D. R. Secrist (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 17, 1962. Contract W-31-109-Eng-52. 44p.

An investigation was carried out to determine the effects of lithium in the boron-carbon system. The results provide a basis for the evaluation of irradiated boron carbide, where the reaction $B^{10}(n,\alpha)Li^7$ occurs. A study of the phase relationships in the lithium-boron and lithium-carbon systems was necessary. Compositions in the lithium-carbon system ranging from 5 to 55 at.% lithium were quenched from temperatures between 350 and 700°C. An x-ray analysis of the samples indicated that only one form of lithium carbide was present with free graphite or lithium. A single crystal of the material was examined by the Weissenberg x-ray technique. The unit cell was identified as monoclinic with the following lattice parameters: $a_0 = 7.801 \pm 0.002$Å, $b_0 = 8.81 \pm 0.1$Å, $c_0 = 10.865 \pm 0.005$Å, and $\beta = 103.2 \pm 0.1$ deg. Based on the reported density of 1.65 gm/cm^3, each unit cell contained 19 molecules of Li_2C_2. The x-ray density was measured to be 1.644 gm/cm^3. Lithium-boron compositions containing from 3 to 55 at.% lithium were quenched from 1000°C. Similar compositions were also furnace cooled from 600°C. An x-ray analysis of the samples indicated the existence of a new phase, present in small quantities at 9 at.% lithium, and predominant at 32 at.% lithium. A chemical analysis of various samples indicated that lithium and boron may form the compound, $B_{12}Li$. Compositions containing from 7 to 71 at.% lithium mixed with boron carbide particles were reacted at 600 and 700°C. Examination by x-ray, petrographic, and chemical methods indicated that both lithium carbide and lithium boride were formed. No ternary compounds were observed. A substantial increase in the amount of extractable boron (free boron or boron combined as Li_xB_y, but not boron combined as B_4C) suggested that the boride reaction was predominant. An accurate quantitative analysis could not be made because of the variable loss of lithium by diffusion into the iron reaction capsules. (auth)

12097 (LAR-1) REACTOR MATERIALS STUDY. RESEARCH AND DEVELOPMENT OF METAL HYDRIDES. Quarterly Report No. 1 [for] October 1, 1958 to December 31, 1958. Richard L. Beck and William M. Mueller (Denver. Univ. Denver Research Inst.). Jan. 15, 1959. Contract AT(33-3)-3. 18p.

Hydriding of relatively massive specimens of zirconium was associated with severe cracking, apparently during sesqui-hydride compound formation. This condition can be obviated by controlling the rate of availability of hydrogen. Pressure-temperature-composition data for the titanium-hydrogen system are presented. The phase diagram developed for this system shows a eutectic at a value estimated as being the best average value obtained by other investigators and a beta-gamma region extending to higher hydrogen contents than determined by other investigators. Pressure-temperature-composition and hardness data for gadolinium hydride and survey data for scandium hydride are given. (auth)

12098 (LAR-2) REACTOR MATERIALS STUDY. RESEARCH AND DEVELOPMENT OF METAL HYDRIDES. Quarterly Report No. 2 [for] January 1, 1959 to March 31, 1959. Richard L. Beck and William M. Mueller (Denver. Univ. Denver Research Inst.). Apr. 15, 1959. Contract AT(33-3)-3. 30p.

The ease of preparation of relatively large crack-free hydrided specimens was found to be largely dependent on the phase state of the hydride at the hydriding temperature. Cracking apparently resulted from hydrogen concentration gradients (with resulting phase concentration gradients) within a two phase region. The control of grinding cracks in the preparation of hydrided tensile specimens is described. Preliminary tensile testing and thermal conduc-

tivity data for zirconium hydride and thermal expansion data for titanium-base alloy hydrides are given. The titanium-hydrogen system is described in detail and pressure-temperature-composition data for the hydrides of titanium-base alloys with selected rare earths are given. It appears that the most promising titanium-rare earth binary alloy for shielding applications is one containing about 40 wt % gadolinium. Apparently the solubility of the 4f rare earths in titanium increases with increasing atomic number. The effects of alpha and beta stabilization of titanium on its hydriding characteristics are shown. (auth)

12099 (LAR-3) REACTOR MATERIALS STUDY. RESEARCH AND DEVELOPMENT OF METAL HYDRIDES. Quarterly Report No. 3, April 1, 1959 to June 30, 1959. Richard L. Beck (Denver. Univ. Denver Research Inst.). July 15, 1959. Contract AT(33-3)-3. 32p.

As an aid in interpreting the physical and mechanical properties data obtained for zirconium hydride, an investigation of the Zr-H phase diagram was undertaken. This study showed that the first hydride phase formed has a body centered orthorhombic structure and contains 62 at.% hydrogen. At higher compositions it appears that the true equilibrium structure is not obtained in normal practice because of the existence of a martensitic transition phase. A study of the thermal expansion properties of zirconium hydride indicated that hydrides containing less than about 55 at.% hydrogen would be unsuitable for use above the eutectoid temperature (540°C), but that higher compositions should be quite acceptable. Thermal conductivity data are also presented which recommend the use of hydrides containing more than about 55 at.% hydrogen. However, mechanical tests showed that zirconium hydride loses essentially all ductility at compositions above about 55 at.% even at temperatures as high as 700°C. The hydriding characteristics of potential shield materials based on gadolinium, titanium-gadolinium, and titanium-vanadium-gadolinium are presented. Preliminary tensile data are given for gadolinium hydride and a titanium-40 wt.% gadolinium hydride. Complete PTC data are presented for the hydrides of erbium and dysprosium up to compositions exceeding the di-hydride. Density and hardness curves are also shown for these hydrides. (auth)

12100 (LAR-4) REACTOR MATERIALS STUDY. RESEARCH AND DEVELOPMENT OF METAL HYDRIDES. Quarterly Report No. 4 [for] July 1, 1959 to September 30, 1959. Richard L. Beck (Denver. Univ. Denver Research Inst.). Oct. 30, 1959. Contract AT(33-3)-3. 24p.

Activities during the period were directed primarily toward determination of the engineering properties of hydrided materials. The tensile strength and elongation, thermal expansion, thermal conductivity, and heat capacity of ZrH were determined as functions of temperature and H content. Preliminary results of Ti-base material studies indicate that these materials can be used for shielding and structural materials with the incorporation of rare earth hydrides. A summary of the work from Oct. 1958 to Sept. 1959 is included. (J.R.D.)

12101 (LAR-7) REACTOR MATERIALS STUDY. RESEARCH AND DEVELOPMENT OF METAL HYDRIDES. Fifth Quarterly Report [for] October 1, 1959 to December 31, 1959. Richard L. Beck (Denver. Univ. Denver Research Inst.). Jan. 15, 1960. Contract AT(33-3)-3. 16p.

The development of a high N_H zirconium hydride with significantly improved toughness at or near room temperature is discussed. Twelve different alloys were prepared and subsequently investigated by means of PTC relations, metallography, and hardness. Two of these alloys (5 at.% Al and 2 at.% Ta) were shown to form solid solutions with delta phase zirconium hydride at room temperature. Data are presented which suggest that both Cu and Fe have appreciable solubilities in delta phase zirconium hydride, but lower alloy contents will have to be investigated. Of the remaining alloys, additional studies were indicated for alloy additions of Ni, Mo, V, and Sn. The Zr-Th-H system was shown to be isomorphous with the Zr-U-H system. Most of the property studies on pure zirconium hydride were temporarily delayed in order to get the alloy study underway and also to permit a number of equipment modifications to be made. (auth)

12102 (LAR-8) REACTOR MATERIALS STUDY. RESEARCH AND DEVELOPMENT OF METAL HYDRIDES. Quarterly Report No. 6 [for] January 1, 1960 to March 31, 1960. Richard L. Beck (Denver. Univ. Denver Research Inst.). Apr. 1960. Contract AT(33-1)-3. 22p.

The nature and origin of the metastable gamma hydride in the H-Zr system are described. Evidence is presented which shows that the transition from FCC delta to BCT epsilon phase occurs by a diffusionless process which is isomorphous with the "second-order" transition observed in the In-Th system. In the transition, continuing changes in cell dimensions took place as more H was added. The densities of the delta and epsilon phases were determined as a function of hydrogen content. The beneficial effects of Ta, Cu, Fe, Ni, Sc, Mo, Al, and V on the mechanical properties of ZrH are discussed. (C.J.G.)

12103 (LAR-9) REACTOR MATERIALS STUDY. RESEARCH AND DEVELOPMENT OF METAL HYDRIDES. Quarterly Report No. 7 [for] April 1, 1960 to June 30, 1960. Richard L. Beck (Denver. Univ. Denver Research Inst.). July 1960. Contract AT(33-3)-3. 16p.

High-temperature x-ray diffraction experiments provided confirming evidence regarding the origin of the metastable gamma phase and of the general features of the zirconium-hydrogen phase system. These experiments also showed that the reaction alpha + delta → beta (the eutectoid reaction on heating) proceeds at an extraordinarily slow rate, although the reverse reaction proceeds so rapidly that beta phase cannot be retained to room temperature by quenching. The sluggishness of the eutectoid reaction on heating undoubtedly resulted in erroneous interpretation of certain physical and mechanical properties determined previously in this and other investigations. Determination of the mechanical properties of zirconium hydride containing various minor alloy additions is continuing. Although these data are still quite sketchy, alloy additions of 5 at.% Sc or 2.2 at.% Cu show the most promise at this time. (auth)

12104 (LAR-10) RESEARCH AND DEVELOPMENT OF METAL HYDRIDES. Summary Report [for] October 1, 1958-September 30, 1960. Richard L. Beck (Denver. Univ. Denver Research Inst.). Nov. 1960. Contract AT (33-3)-3. 93p.

A detailed study of the fundamental relations in the zirconium-hydrogen system was made in order to clarify the many points of dispute and to evolve a complete picture describing all phases of this system. An engineering evaluation was made of means for utilizing the various high cross-section metal hydrides in shielding or control applications. These materials would combine the processes of thermalization and absorption. Consequently, they are of considerable interest for use in shielding or controlling epithermal reactors. (auth)

12105 (NAA-SR-6880) X-RAY STUDIES OF δ AND ϵ ZIRCONIUM HYDRIDES. W. L. Korst (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 30, 1962. Contract AT(11-1)-GEN-8. 19p.

Fifteen samples of zirconium hydride ranging in composition from $ZrH_{1.646}$ to $ZrH_{1.997}$ were prepared, and examined by means of x-ray diffraction. The minimum range of coexistence at room temperature of the face-centered cubic δ-phase and the face-centered tetragonal ϵ-phase was found to lie approximately between $ZrH_{1.64}$ and $ZrH_{1.73}$. The lattice parameters corresponding to the patterns obtained were computed using a least-squares method with application of the Nelson-Riley correction function. The c/a ratios obtained for the samples of different compositions of the ϵ-phase were compared with values reported previously. (auth)

12106 (NP-11374) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Frazier, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Jan. 1962. 73p.

A bibliography of 128 abstracts is presented on high-strength alloys, light metals, nonmetallics, refractory metals, coatings, applications, and composites. (D.L.C.)

12107 (NP-11434) RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STRUCTURAL ADHESIVES. Quarterly Progress Report No. 5, September 1, 1961 to January 31, 1962. Sven H. Ruetman and Harold H. Levine (Narmco Research and Development. Div. of Telecomputing Corp., San Diego, Calif.). Feb. 1962. Contract NOw 61-0254-c. 66p.

Constructive pyrolysis of silicone-phenolic laminates at elevated temperatures in argon indicated a major structural change in the resin at 1250°F. This change was shown by a very large decrease in volume resistivity of the specimens. Approximately the same outstanding oxidation resistance and good retention of high temperature tensile shear strength were obtained at 1500° and 1800°F. When exposed to air for 30 hours at 650°F a refrasil laminate, made with zirconium phenoxy-aldehyde resin, underwent complete oxidative destruction, despite the previous constructive pyrolysis in argon at 1800°F. A laminate made with phosphonitrilic chloride-hydroquinone condensation products (Dynalak-HU) delaminated at 500°F in an argon atmosphere. Nevertheless, the 1800°F pyrolyzed specimens had good oxidation resistance at 650°F, in air. Rocket nozzle liners, made by pyrolysis of phenolic laminates, had an erosion of 0.050 in. in a 0.5 second test. An epoxy-novolac adhesive cured with As_2S_3 + As_2O_5 had a tensile shear strength of 940 psi after 10 minutes at 1000°F. Another formulation containing As_2O_3 in place of As_2O_5 gave 975 psi after 1000 hours at 500°F and 855 psi after 10 minutes at 1000°F. $As^{+3}As^{+5}S_4$ + As_2O_3 in epoxy-novolac adhesive gave a tensile shear strength of 2135 psi at room temperature, which was one of the highest obtained in the current series. 9-Fluorenone and 9,9′-difluorenyl were the two products isolated from the pyrolysis of fluorene in the presence of air at 245 to 250°C. When a small amount of perylene was included in the pyrolysis mixture, mostly 9,9′-di-fluorenyl was isolated. The products from pyrolysis of bis-(2-hydroxyphenyl)methane in presence of air are now being separated and identified. 1,4-Butanediphosphonic acid was prepared from triisopropylphosphite and 1,4-dibromobutane. Arsenic thioarsenate was prepared from disodium arsenate and hydrogen sulfide, followed by the treatment with arsenic trioxide in basic media. Attempted synthesis of 9,9′-difluorenyl from 9-bromofluorene utilizing the Wurtz reaction resulted in 9,9′-difluorenylidene. Bis-(2-hydroxyphenyl)methane was made by dehalogenation of commercially available bis-(5-chloro-2-hydroxyphenyl) methane with sodium in liquid ammonia. Attempts to condense thiophenol with formaldehyde resulted in low molecular weight, structurally not yet identified polymers. 1,2-Propylene sulfide was made from 1,2-propylene oxide and thiourea. 1-Chloro-2,3-propylene sulfide was synthesized in 35% yield from epi-chlorohydrin and thiourea. β-Hydroxythiouronium benzoates from epichlorohydrin and phenylglycidyl ether were made in good yields to be used as intermediates in thiirane compound synthesis. However, polymerization occurred upon neutralization of the benzoates with sodium carbonate. 2,3-Octylene oxide failed to react with thiourea. 1,2-Dodecene sulfide was tentatively synthesized in 20% yield from 1,2-dodecene oxide and thiourea. Tetra(dimethylamino)diboron was reacted with o-phenylenediamine to yield bis-(o-phenylenediamino) diboron. The product from the reaction of cacodylic acid with tetra(dimethylamino)diboron has yet to be identified. (auth)

12108 (NYO-8121) REVIEW AND COMMENTARY ON SOME RUSSIAN WORK ON TRANSPORT PROPERTIES IN MOLTEN OXIDES. Alexandre Berlin ([New York Univ., New York]). Feb. 19, 1962. Contract AT 30-1-1837. 24p.

Research work on the transport numbers of cations in ternary systems $Me_xO_y \cdot Me'_{x'}O_{y'} \cdot aSiO_2$ is reviewed. Twenty-eight different systems were investigated. The possible presence of free Al^{3+} ions in $aCaO \cdot bAl_2O_3 \cdot cSiO_2$ melts is discussed. For the alkali-alkaline earth metal oxides – SiO_2 systems the "cationic coordinate number difference rule," as developed by Malkin, is presented and discussed. It is felt that the numerical values obtained for the transport numbers are not reliable and no mathematical correlation should be attempted. Some suggestions for further work in this field are mentioned. (auth)

12109 (ORO-518) THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Fifth Monthly Report. Frank J. Digesu (Southern Research Inst., Birmingham, Ala.). Jan. 19, 1962. Contract [AT(40-1)-2694]. 25p.

Activities in a program for determination of the true stress-strain properties of brittle materials at low temperatures to 5000°F are reported. The test system development program to provide maximum performance of all components including essentially full automation is described. Other investigations are devoted to evaluation of the influence of some specimen variables on the mechanical properties and evaluating selected refractory materials as the program progresses. All of the major modifications except the automatic control of the gas flow to the gas bearings were completed. A significant reduction was made in the setup time required for each run, and the operation of the equipment was considerably simplified. To provide a clear understanding of the modifications and refinements completed and their significance, a detailed discussion of the work completed to date is presented. To confirm the improved performance of the refined stress-strain facility, several runs on test specimens were made. Some typical curves obtained with the system are included. The facility is capable of obtaining data on tensile, shear, and compression from room temperature and below to over 5000°F. An application for patent on the process and apparatus of the uniaxial gas bearing system has been filed. A copy of this application is included. (auth)

12110 (TID-14770) A STUDY OF HIGH TEMPERATURE PROPERTIES OF TITANIUM AND ZIRCONIUM

PHOSPHIDES AND RELATED REFRACTORY MATERIALS. Progress Report for the Period, January 1, 1961 to December 31, 1961. Karl A. Gingerich (Pennsylvania State Univ., University Park). Jan. 1962. Contract AT(30-1)-2541. 27p.

Progress is reported on developments in the studies of the phase relations of tantalum, titanium, and zirconium phosphides, and the mass spectrometric studies of the vaporization characteristics of niobium, titantium, thorium, and tungsten phosphides. (B.O.G.)

12111 (TID-14779) CONTINUED STUDIES OF RARE-EARTH ALLOYS WITH TRANSITION METALS. Progress Report for the Period May 1, 1961–November 30, 1961. A. A. Burr, W. R. Clough, J. C. Uy, D. B. Jugle, F. W. Cooke, A. P. Lee, B. T. M. Loh, P. Khangaonkar, and H. Andrews (Rensselaer Polytechnic Inst., Troy, N. Y.). Jan. 18, 1962. Contract [AT(30-1)-2159]. 11p.

Studies are reported of the preparation, x-ray-diffraction analysis, quenching characteristics, metallographic surface preparation, and resistivity measurement methods of Th–rare earth alloys. Also studied are the zone melting, surface tension measurement methods, calorimetry, and recrystallization behavior of Zr–rare earth alloys. (T.F.H.)

12112 (TID-15074) THE MECHANISMS OF FISSION GAS DIFFUSION IN GRAPHITE. Summary Report, June 1, 1961–May 31, 1962. W. S. Diethorn and P. L. Walker, Jr. (Pennsylvania State Univ., University Park). Feb. 20, 1962. Contract AT(30-1)-2792. 19p.

Studies are being carried out to investigate the mechanisms of fission gas diffusion from graphite powders and bodies prepared from these powders. The selection and characterization of graphites and the construction of apparatus for the post-irradiation study of fission gas release from graphite materials are discussed. The carbon materials to be studied include natural graphites, petroleum cakes, graphite single crystals, and multicrystalline carbons. (M.C.G.)

12113 (TID-15160) DIFFUSION OF RADON AND TRITIUM THROUGH SEMIPERMEABLE MATERIALS. Technical Progress Report. Elmer Nussbaum (Taylor Univ., Upland, Ind.). Mar. 1962. Contract AT(11-1)-649. 27p.

The rates at which radon and tritium are diffused through sheets of rubber vulcanizates, plastic films, and papers were investigated. A modified reaction flask, with semipermeable membrane interposed between glass hemispheres, was used in the diffusion studies. Samples containing radon or tritium were assayed for γ activity. Data from typical experiments are tabulated. Results indicate that the diffusion of tritium proceeds more slowly than radon at the same temperature through all rubber vulcanizates tested, but more rapidly through certain plastic films and wax-coated papers. The diffusion of radon and tritium through semi-permeable materials was found to be directly related to temperature, but there appears to be a wide variation in the effectiveness of change in temperature on transmission rates. (C.H.)

12114 (TID-15195) STRUCTURE OF LIQUID METALS. [Progress Report], June 1961–February 1962. R. B. Gordon (Yale Univ., New Haven). Feb. 1962. Contract AT(30-1)-2029. 30p.

A calculation of the change in Hall coefficient in Cu_3Au with ordering is being made on the basis of nearly free electron theory. The occurrence of a positive Hall constant in the ordered alloy was explained on this basis. Magnetoresistance measurements on Cu_3Au were made as a function of domain size and degree of long range order. The results are compared with previous Hall effect experiments. Measurements of the Hall effect in liquid mercury are reported. (auth)

12115 (WADD-TR-60-438) ELEVATED TEMPERATURE DYNAMIC ELASTIC MODULI OF VARIOUS METALLIC MATERIALS. W. H. Hill and K. D. Shimmin (Wright Air Development Div. Materials Central, Wright-Patterson AFB, Ohio). July 15, 1960. 76p. (AD-264825)

The dynamic elastic moduli of 40 metals and alloys of engineering interest were determined at room and elevated temperatures. Modulus determinations were based upon a relation between the speed of sound in a material and its elastic modulus. A specimen of the material was excited electrostatically and its resonant frequency determined. Knowing the geometry of the specimen, the dynamic elastic modulus was calculated. Room temperature comparisons of dynamic with static moduli were made in most instances using material from the same bar. The results of dynamic elastic modulus determinations are graphically presented. (auth)

12116 (WADD-TR-60-864) THE TECHNOLOGY OF SCANDIUM, YTTRIUM, AND THE RARE EARTH METALS. A LITERATURE SURVEY. Bernard Love (Research Chemicals. Div. of Nuclear Corp. of America, Burbank, Calif.). Oct. 1960. Contract AF 33(616-6829). 242p.

A survey has been made of the unclassified literature relating to the rare earth elements. The best available data were compiled from 939 references for the abundance and distribution of the elements, the methods of recovery from ores, separation and purification techniques, and procedures for reduction to metal. The physical, chemical, and mechanical properties of the elements and their important compounds are presented. (auth)

12117 (AEC-tr-5022) CRYSTAL CHEMISTRY OF METAL CARBIDES AND THEIR IMPORTANCE IN METALLURGY. W. Epprecht. Translated from Chimia (Switz.), 5: 49-60(1951). 37p.

The crystal chemistry of selected metal carbides is examined. Included are discussions of lattice structures and the effects of carbides in alloys. (J.R.D.)

12118 (AEC-tr-5035) STUDY OF THE ELECTRICAL RESISTIVITY OF ZIRCONIUM. APPLICATION TO THE STUDY OF THE RECRYSTALLIZATION OF THE METAL AFTER COLD WORK. INFLUENCE OF THE PURITY. L. Renucci, J. P. Langeron, and P. Lehr. Translated by D. G. Westlake (Argonne National Lab., Ill.) from Mém. sci. rev. mét., 58: 699-715(1961). 28p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 3495.

12119 (CEA-tr-A-1039) RECHERCHES SUR L'OXYDATION DU Zr UTILISE DANS LES REACTEURS. (Research on the Oxidation of Reactor-Grade Zirconium). G. Saur, H. J. Laue, and H. Borchers. Translated into French from Metall, 15: 9-18(1961). 35p. (Includes original, 10p.).

Relationships are found governing the oxidation of Zr at 300 to 900°C. The activation energies are also found in this temperature range. The effects of the samples' dimensions on their oxidation are studied. In the practical domain of utilization of Zr in an oxidizing atmosphere (up to 600°C), the differences between the oxidation of plaques and cylinders are small, but a strong dependence on surface roughness is observed. Determinations of the thickness of the surface layer by measurements of the hardness,

theoretical calculations, and microscopic examinations are not in agreement. It is concluded that there is no difference between the structures of the white and dark forms of ZrO_2 found on Zr surfaces. The appearance of the white oxide is attributed to the formation of fissures caused by internal tensions. The surface condition of the sample is considered to be the most important factor in the onset of the white form with increasing temperature. (T.F.H.)

12120 (FTD-TT-61-240) COMPOUNDS OF HAFNIUM WITH BERYLLIUM, THEIR CRYSTALLINE STRUCTURE AND CERTAIN PROPERTIES. P. I. Kripyakevich, M. A. Tylkina, and E. M. Savitskii (Ye. M. Savitskiy). Translated from Zhur. Strukt. Khim., 2: 424-33(1961). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 6760.

12121 INTERATOMIC DISTANCES IN THE INTERMETALLIC COMPOUNDS $MgBe_{13}$ AND $CaBe_{13}$. T. W. Baker (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Acta Cryst., 15: 175-9(Mar. 10, 1962). (AERE-R-3456)

A least-squares refinement of the atomic positional parameters y and z, for the Be_{II} atoms in $MgBe_{13}$ and $CaBe_{13}$, was carried out. This is based upon intensity measurements on polycrystalline material, using a proportional-counter diffractometer, and point-counting procedure. The treatment of measurements is discussed and a weighting scheme appropriate to counting methods is suggested. The results obtained are: $MgBe_{13}$: $y = 0.1789 \pm 0.0010$, $z = 0.1143 \pm 0.0008$ and $CaBe_{13}$: $y = 0.1769 \pm 0.0002$, $z = 0.1123 \pm 0.0002$. The uncertainties are the calculated standard deviations. (auth)

12122 THE STRUCTURES OF $NiZr_2$, NiZr AND THEIR HAFNIUM ANALOGS. M. E. Kirkpatrick, D. M. Bailey, and J. F. Smith (Ames Lab., Ames, Iowa). Acta Cryst., 15: 252-5(Mar. 10, 1962). (IS-196)

The crystal structures of the intermediate phases $NiZr_2$ and NiZr were determined by single crystal methods. The structure of the tetragonal $NiZr_2$ phase was found to be the C16 type with space group symmetry D_{4h}^{18}–I4/mcm. The lattice dimensions for this phase were found to be $a_0 = 6.477$ and $c_0 = 5.241$ Å. Lattice dimensions for the orthorhombic NiZr lattice were found to be $a_0 = 3.268$, $b_0 = 9.937$, and $c_0 = 4.101$ Å. The structure of NiZr was established as the B_f structure with D_{2h}^{17}–Cmcm space group symmetry. Sufficient data on $NiHf_2$ and NiHf were taken to verify that these compounds are isostructural with their corresponding zirconium compounds. (auth)

12123 MEASUREMENT OF ELECTRON ELASTIC SCATTERING INTENSITIES BY POLYCRYSTALLINE ALUMINUM FOILS. M. Horstmann and G. Meyer (Universität, Hamburg). Acta Cryst., 15: 271-81(Mar. 10, 1962). (In German)

By means of a retarding field apparatus the intensities of electrons scattered elastically by polycrystalline Al-foils were measured. The influence of crystal size (35 to 250 Å) and electron energy (20 to 50 kev) on the relative intensities of the Debye-Scherrer-rings was investigated systematically. For crystals smaller than 90 Å the results agree within 10% with the values calculated from the kinematical theory. If the crystal size exceeds 90 Å deviations from the kinematical, intensity values are observed, which can be interpreted quantitatively by the two-beam approximation of the dynamical theory. The half-width of the different rings is discussed. The mean crystal size calculated from the width of the rings is compared with the mean thickness of the crystals determined from the dynamical extinction effects. (auth)

12124 A COMPARISON OF THE STRUCTURES Zr_2Al_3 AND $ZrAl_2$. T. J. Renouf (Univ. of Edinburgh). Acta Cryst., 15: 282-3(Mar. 10, 1962).

A projection of Zr_2Al_3 down the c axis is shown. The space group is Fdd2 with $a = 9.601$, $b = 13.906$, and $c = 5.574$ Å. $ZrAl_2$ is hexagonal with $a = 5.282$, $c = 8.748$ Å, and $c/a = 1.656$. The space group is $P6_3/mmc$, the structure being a Laves phase of the C14, $MgZn_2$ type. For comparison, however, it is convenient to choose an orthohexagonal form with $a = 5.582$, $b' = 2a \cos 30° = 9.148$, and $c = 8.748$ Å and to compare the projection of two of these cells down the a axis as shown with the projection of Zr_2Al_3. The results show that $ZrAl_2$ can be described as the two Laves sequence types stacked alternately, two sequences being sufficient to furnish the repeat unit; and Zr_2Al_3 can be described as two similar sequence types also stacked alternately but staggered so that four sequences are required to produce the repeat unit. In $ZrAl_2$ the hexagons of a kagome net are centered by zirconium atoms from both sides. In Zr_2Al_3 the sequences are staggered so that one of these zirconium atoms is placed at the vacant site of the kagome-type aluminum layer, thus producing a puckered triangular net. This might be taken to account for a relative contraction in the direction of stacking. (N.W.R.)

12125 ATOMIC SCATTERING FACTORS FOR YTTERBIUM. Edgar L. Eichhorn and Michael W. Holm (Burroughs Corp., Pasadena, Calif.). Acta Cryst., 15: 294 (Mar. 10, 1962).

The atomic scattering factors for ytterbium are given. The values were obtained from computations of the atomic wave field calculated by the Hartree procedure. It is intended to utilize these data to incorporate Fock corrections. (N.W.R.)

12126 AN X-RAY SPECTROSCOPIC STUDY OF THE TITANIUM BERYLLIDES HAVING A HIGH CONTENT OF BERYLLIUM. E. E. Vainshtein, S. M. Blokhin, and P. I. Kripyakevich (Inst. of Inorganic Chemistry, Siberian Branch, Academy of Sciences, USSR and L'vov State Univ., USSR). Doklady Akad. Nauk S.S.S.R., 142: 85-7(Jan. 1, 1962). (In Russian)

Alloys containing 88, 90 and 93 at. % Be were made by fusing titanium and beryllium in corundum crucibles in an argon atmosphere. X-ray analysis indicated the formation of Ti_2Be_{17} similar in structure to Th_2Zn_{17} (space group R 3m, Z = 3). The basic trigonal lattice constants of Ti_2Be_{17} were $a = 7.40$ Å, $c = 10.84$ Å and $c/a = 1.465$. It is not certain whether the alloy with 93% Be is a solid solution of Ti_2Be_{17} or a compound with the formula $TiBe_{12}$. It was possible to detect additional details of the fine structure in the absorption spectrum of alloys low in beryllium (titanium with $TiBe_2$). Alloys with a high content of beryllium (90 at. % Be) showed substantial and characteristic changes in the absorption and emission spectra of the transition metal. There was a sharp change in the long wavelength structure of the absorption edge due to transfer of a K-electron to a hybridized energy band in the alloy. On going from the diberyllide to Ti_2Be_{17}, the emission spectrum shows a sharp symmetrization of the $K\beta_5$ emission bands of titanium (the position of the short wavelength edge does not change) and the appearance of a $K\beta$ satellite which is usually lacking in the spectrum of pure metals or of alloy components with complete collectivization of valence electrons. Thus, the absorption and emission spectra of titanium in Ti_2Be_{17} indicate a decrease in overlapping of the energy bands of the valence electrons of the alloy components and an increase in the Be-Be interaction. (TTT)

12127 A NEW CALCULATIONAL METHOD OF DETERMINING THE THERMODYNAMIC PROPERTIES OF LITHIUM IODIDE IN A MASS SPECTROMETER HAVING A DOUBLE EFFUSION CHAMBER. L. N. Gorokhov (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 142: 113-16 (Jan. 1, 1962). (In Russian)

A system of two chambers connected by a 1 mm channel (a double effusion chamber) is maintained at a temperature T_1 in the lower chamber and at a temperature T_2 in the upper chamber. The vapor escaping from an opening in the upper chamber is subjected to a mass-spectrometric analysis. Changes in the relative composition of dimer to monomer p_d/p_m can be determined by measuring the ion currents as a function of T_2 at T_1 = const. The composition of the vapor in the upper chamber is determined by the equilibrium constant for the dissociation of the dimer (Dimer $\rightleftharpoons$ 2 Monomer) at a temperature T_2, and by the total pressure. All the required information can be obtained by a single series of measurements. The upper chamber is heated to its maximum temperature $T_2(max)$ and then T_2 is decreased in steps with T_1 = const. Over a narrow temperature range $K_c = C_m^2/C_d$ depends linearly on $1/T_2$ as does the ratio of the ion currents I_m^2/I_d. The mass-spectrum of LiI showed a preponderance of the monomer LiI^+ and of the dimer Li_2I^+. A plot of I_1^2/I_2 gave a straight line, and the heat of dissociation of the dimer was calculated as 41.6 ± 0.3 kcal/g-mol at 722°K. The heat of dissociation of the trimer was found to be 32.7 ± 0.6 kcal/g-mol. The ratio of the pressures of the dimer to that of the monomer was $p_d/p_m = 6$. The absolute pressure of the monomer at 722°K was $p_m = 3 \times 10^{-3}$ mm Hg, as found by calibration with silver vapor. (TTT)

12128 DIFFUSION OF NIOBIUM AND CARBON INTO NIOBIUM AND ITS CARBIDES. P. V. Gel'd and V. D. Lyubimov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 6, 119-26(Nov.-Dec. 1961). (In Russian)

Nb^{95} and C^{14} were used in determining the diffusion of Nb and C in metallic niobium and in some of its carbides. The activation energies were determined for niobium diffusion in metal (85 kcal/g-at.) and in its carbide $NbC_{0.98}$ (55 kcal/g-at.) as well as for carbon in niobium (32 kcal/g-at.) and in $NbC_{0.96}$, $NbC_{0.75}$, and $NbC_{0.5}$ (~32 to 33 kcal/g-at.). (R.V.J.)

12129 STABILITY OF β-PHASE SOLID SOLUTION OF Ti–Fe–V ALLOYS. N. V. Ageev, O. G. Karpinskii, and L. A. Petrova. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 6, 127-9(Nov.-Dec. 1961). (In Russian)

Metallographic, x-ray diffraction, and hardness analyses were made of the effects of vanadium on the β-phase stability of Ti–Fe alloys and of iron on Ti–V alloys. The investigations were made with Ti–Fe–V alloys annealed in water at 900 and 800°C and heated at 100 to 400°C for 0.25 to 100 hours. (R.V.J.)

12130 HIGH-TEMPERATURE STABILITY OF METAL COMPOUNDS. I. I. Korhilov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 6, 130-6(Nov.-Dec. 1961). (In Russian)

The heat resistance of metallic compounds is compared with the heat resistance of pure metals and solid solutions. It is shown that the high heat resistance of certain metallic compounds is a result of strong chemical bonding. Among the many nickel compounds, the highest heat resistance with sufficient plasticity is found in Ni_3Al. Ti_6Al, Ti_3Al, and TiAl possess higher heat resistance than pure titanium. (R.V.J.)

12131 SUPERCONDUCTIVITY IN HEAT-TREATED Nb–Zr ALLOYS. G. D. Kneip, Jr., J. O. Betterton, Jr., D. S. Easton, and J. O. Scarbrough (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 33: 754-5(Feb. 1962).

A tenfold increase in critical current density was achieved by short heat treatments of Nb–Zr superconductors subjected to cold deformation. The two effects are additive, and the highest critical current densities are attained by the proper combination. Critical current density data for 72% Nb–28% Zr at 4.2°K are presented in graphical form. (L.N.N.)

12132 GROOVE ETCHING IN URANIUM MONOSULPHIDE. J. P. Hugo and P. D. Shalek (Argonne National Lab., Ill.). J. Inst. Metals, 90: 215-16(Feb. 1962). (ANL-FGF-264)

An unusual groove-etching phenomenon was encountered in a number of relatively high-density, high-purity, sintered uranium monosulfide bodies. Etching generated a Widmanstatten pattern in the uranium monosulfide matrix. Electron micrographs established that the pattern consisted of etching grooves and not a dispersed phase and also revealed that the wide grooves do not contain steps and are in fact shallow, plain, flat-faceted grooves. It is clear, therefore, that groove etching in uranium monosulfide is a manifestation of preferential crystallographic etching attack. The Widmanstatten character of the groove etching indicates that in all probability the (111) planes of the f.c.c. uranium monosulfide are suffering preferential attack. Thus, the grooves suggest that they represent the selective etching of stacking faults. (N.W.R.)

12133 THE EFFECT OF SMALL ADDITIONS OF YTTRIA ON THE PLASTICITY OF URANIUM OXIDES AT 940°C. G. Christie and J. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 5: 1-4(Jan. 1962). (AERE-R-3702). (In English)

The creep-in-bend behavior of yttria/urania solid solutions containing 0.5 and 1 wt % Y_2O_3, both in the fully reduced and oxidized states, was studied at 940°C under a maximum fibre stress of 5000 psi. The fully reduced solutions do not deform plastically under these experimental conditions, but yttrium additions to $UO_{2.15-2.20}$ reduce its plasticity. The behavior of the reduced solutions is explicable in terms of the hypothesis already advanced to explain improved plasticity in UO_{2+x} compared with stoichiometric UO_2. Possible explanations for the behavior of the oxidized solid-solutions are discussed. (auth)

12134 THE SELF-DIFFUSION OF ALPHA-URANIUM. R. Resnick and L. L. Seigle (General Telephone and Electronics Labs., Bayside, N. Y.). J. Nuclear Materials 5: 5-11(Jan. 1962). (In English)

The self-diffusion coefficient of alpha-uranium was measured as a function of crystallographic direction at 640°C, using the decrease in surface activity method. The average of two measurements made in each direction are: $D_{[100]} = 1.8 \times 10^{-14}$ cm²/sec, $D_{[010]} = 0.72 \times 10^{-14}$ cm²/sec, and $D_{[001]} = 0.66 \times 10^{-14}$ cm² sec. The anisotropy in diffusion is not nearly so large as was anticipated. (auth)

12135 THE DENSITY OF LIQUID BISMUTH AND OF DILUTE SOLUTIONS OF COPPER IN LIQUID BISMUTH. S. W. Strauss and L. E. Richards (U. S. Naval Research Lab., Washington, D. C.). J. Nuclear Materials, 5: 12-16 (Jan. 1962). (In English)

Using a modified Archimedean method, the density of liquid bismuth was measured in the range 400 to 800°C, and densities of liquid bismuth-copper solutions containing

up to about 3.5 at. % copper were measured in the range 790 to 810°C. The molal volumes of bismuth-copper solutions calculated from the experimentally determined densities were found to be less than those calculated from the rule of mixtures. Partial molal volumes for bismuth and for copper were estimated by the method of intercepts. The results indicate that, as in the case of lead-nickel and lead-copper solutions, the partial molal volume of the solvent, bismuth in the present study, does not differ significantly from its molal volume, and the partial molal volume of the solute approaches a value of zero at high dilution. (auth)

12136 DISLOCATION PATTERNS IN GRAPHITE. P. Delavignette and S. Amelinckx (Centre d'Etude de l'Energie Nucleaire, Mol-Donk, Belg.). J. Nuclear Materials, 5: 17-66 (Jan. 1962). (In English)

A detailed analysis is given of the dislocation patterns observed by means of electron microscopy in graphite single crystal flakes. It is found that the dislocations are ribbons consisting of two partials of the Shockley type separated by a strip of stacking fault. All patterns can be interpreted in a consistent way on the basis of this model and on the assumption that only small energy stacking faults occur, i.e. faults consisting of a lamella of rhombohedrally stacked material. The stacking fault energy is obtained from the width of the dislocation ribbons and from the shape of extended nodes of partials with known Burgers vector. The dependence of the width of the ribbon on the angle between the direction of the ribbon and the Burgers vector is checked, and it is shown that this can be used to determine an effective Poisson's ratio. The possible interactions between ribbons are discussed and compared with observed configurations. Graphite quenched from 3000°C and annealed at 1200°C is found to contain vacancy loops. It is shown that from a determination of the Burgers vector a conclusion as to the nature of the loops can be reached. The interaction between vacancy loops and glissile dislocations is also discussed. It is shown that vacancy loops tend to form preferentially in the stacking fault ribbons. The formation mechanism and the structure of dislocation networks are discussed as well as the nature of the twin boundaries. Dislocation movement and the formation of constrictions in the ribbons are discussed. (auth)

12137 A STUDY OF THE MELTING OF IRRADIATED URANIUM. J. H. Buddery and K. T. Scott (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 5: 81-93 (Jan. 1962). (In English)

A study of the melting of high burn-up irradiated uranium was made, with particular reference to the release of the fission product inert gases. Density changes were recorded by a ciné-photographic technique and due to the gross swelling caused by gas bubbles, values as low as 2 to 4 g/cm^3 were observed shortly after melting. During the expansion bubbles of up to 3 mm diameter were formed. Uranium burn-up and irradiation temperature had little effect on the gas release as measured by counting Kr^{85}. The gas release was studied in greater detail by quenching the uranium at progressive intervals after the release became rapid. This rapid release was found to begin in the solid uranium about 10°C below the melting point. At this point the strength of the uranium is so low that the internal pressure of the fission gases in the bubbles and cracks is sufficient to extend many of them to the surface. More than 99.5% of the Kr^{85} was lost on melting, and the final configuration was a pool of almost full density uranium covered by a low density froth. (auth)

12138 THE RELEASE OF KRYPTON 85 FROM IRRADIATED URANIUM ON THERMAL CYCLING THROUGH THE PHASE CHANGES. K. T. Scott and J. H. Buddery (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 5: 94-100 (Jan. 1962). (In English)

The release of Kr^{85} from high burnup uranium on cycling through the phase changes was studied by a gas entrainment and counting technique. It was shown that significant releases occur, especially at the α-β phase transformation. The magnitude of the release depends upon the previous history of the uranium. (auth)

12139 DETERMINATION OF THE GLIDE ELEMENTS FOR HEXAGONAL METALS BY ASTERISMS IN LAUE PHOTOGRAPHS AND APPLICATION TO A STUDY OF DEFORMATION IN BERYLLIUM AT HIGH TEMPERATURE. P. Bastien and P. Pointu (Ecole Centrale des Arts et Manufactures, Paris). J. Nuclear Materials, 5: 101-8 (Jan. 1962). (In French)

It is shown that by analysis of asterisms in Laue photographs it is possible, at any rate for hexagonal metals, to determine the glide elements responsible for the asterisms. This method, applied to beryllium, reveals new modes of deformation active at high temperatures, with a component of glide along the hexagonal axis. (auth)

12140 CHARACTERISTICS OF URANIUM-6 wt % ZIRCONIUM ALLOY. A. Virot (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Materials, 5: 109-19 (Jan. 1962). (In French)

The characteristics of a U-6 wt % Zr alloy in the as-cast state and also its transformation kinetics were determined by means of metallography, dilatometry, x-ray diffraction, and hardness measurement. Thermal cycling tests involving 100 cycles between 20 and 600°C showed that the as-cast alloy has good dimensional stability. The same applies for heat treatments of 2000 hr at temperatures in the range 550 to 625°C. Transformation during continuous cooling at rates from 2.5 to 350°C/min produces lamellar microstructures resulting from $\gamma \rightarrow \alpha$ transformation. Curves show that two transformation mechanisms exist: nucleation and growth above the M_s temperature (475 to 500°C), leading either to lamellae or to a fine precipitate, martensitic transformation, producing a microstructure consisting of orthogonal bands. (auth)

12141 STRUCTURE TRANSFORMATIONS IN ZIRCALOY-2 DURING HOT WORKING PROCESSES. G. Oestberg and R. Attermo (Aktiebolaget Atomenergi, Stockholm). J. Nuclear Materials, 5: 120-7 (Jan. 1962). (In English)

During fabrication of Zircaloy-2 from ingot to final shape the microstructure changes owing to the deformation and the heating. This investigation shows that as a result of forging the Widmanstätten α plates in the ingot are changed into equiaxed α grains. This happens when the hot working is carried out in the $(\alpha + \beta)$ range as well as in the α range. The secondary phase particles are precipitated in the former α/β boundaries and, after reheating and secondary hot working, also in the boundaries between the α grains. The degree of precipitation in the latter sites is governed by the reheating temperature and holding time. Recrystallization after cold working gives the grains of the α matrix the normally observed equiaxed form, their size being unaffected by the secondary phase particles. (auth)

12142 NATURE OF THE $\alpha \rightleftharpoons \beta$ TRANSFORMATION OF URANIUM IN THE VICINITY OF EQUILIBRIUM.

G. Donze (Centre d'Etudes Nucléaires, Saclay, France). J. Nuclear Materials, 5: 150-2(Jan. 1962). (In French)

It is well established that the transformations in weakly alloyed uranium are martensitic at low temperatures. On the other hand, the nature of the transformations in the neighborhood of equilibrium is very controversial. Of the two theses (transformation by germination and growth and martensitic transformation) argued, the thesis of germination and growth proves the $\alpha \rightleftharpoons \beta$ transformation of uranium in the vicinity of equilibrium. The phase transformation kinetics show no martensitic transformation in the vicinity of the equilibrium temperature. (N.W.R.)

12143 MODES OF DEFORMATION OF BERYLLIUM AT HIGH TEMPERATURE AND RECRYSTALIZATION AFTER TWINNING. P. Bastien and P. Pointu (Ecole Centrale des Arts et Manufactures, Paris). J. Nuclear Materials, 5: 153-5(Jan. 1962). (In French)

By light-rolling monocrystals of selected orientation, an important twinning $(10\bar{1}2)$ at 1000 to 1070°C justifies 80% of the total deformation of the crystal. Although it is favored by crystal orientation and the speed of deformation, the appearance of twinning at the melting point is still large enough to be noticeable. One observes that the border of the twin is often wavy with relation to the inclusions and that the extremities are enlarged to give occasionally rectilinear traces according to $(10\bar{1}0)$, indicating stress relaxation at the face of the twin by sliding. (N.W.R.)

12144 BEHAVIOR OF URANIUM MONONITRIDE UNDER HEAT TREATMENT. A. Accary and M. Marchal (Centre d'Etudes Nucleaires, Saclay, France). Mém. sci. rev. mét., 59: 57-70(Jan. 1962). (In French)

The grain growth of uranium mononitride was measured during heat treatment. Statistical as well as morphological methods were used and lead to the following conclusions: The grain growth involves two stages: the first is a recrystallization process which substitutes a stress-free matrix for a stressed one, the second stage being a rearrangement of the grain boundaries, without any bulk energy change. The experiments showed the occurrence, during the grain growth process, of two sets of grains differing in their growth rates. The rate of change of the grain surface area was also measured. This rate, which is roughly constant, involves two different values for the activation energy, each concerning one of the stages mentioned. (auth)

12145 MULTIREGION FUEL ELEMENTS. M. R. Fleishman, A. A. Strasser, and J. E. Wilkins, Jr. (United Nuclear Corp., White Plains, N. Y.). Nuclear Sci. and Eng., 12: 310-11(Feb. 1962).

A multiregion fuel element is described that can be designed to take advantage of the high density and high thermal conductivity of the metal as well as of the high operating temperature of the oxide. This is accomplished by using a rod-shaped element having an outer annulus of metal and a central core of oxide. The discussion is limited to metallic uranium and uranium oxide; however, the same principles apply to various uranium alloys and refractory uranium compounds. Preliminary evaluation of the following four types of fuel elements was made: solid metallic uranium rods, solid uranium oxide rods, cored metallic uranium rods, and multiregion metallic uranium-uranium oxide rods. The evaluation resulted in a conclusion that the multiregion fuel element provides improved performance over the other elements by permitting 20% increase in power generation, 25% increase in burnup, and 1% increase in reactivity. (N.W.R.)

12146 KINETICS OF STRUCTURAL CHANGES DURING BETA TRANSFORMATION OF URANIUM. William R. McDonell (E. I. du Pont de Nemours & Co., Aiken, S. C.). Nuclear Sci. and Eng., 12: 325-36(Mar. 1962).

When uranium with preferred orientation is heat treated at low beta-phase temperatures and cooled in air, grain coarsening proceeds at a more rapid rate than the loss of preferred orientation. Quenching into water from the beta temperature increases the rate of loss of preferred orientation and refines the grain size. To account for these effects, it is postulated that the transformation from the highly oriented alpha phase to the beta phase is incomplete in short times at low beta-phase temperatures, and that during cooling the residual alpha grains serve as centers for retransformation to an oriented, large-grained alpha phase. Quenching increases nucleation from the beta phase, and results in a structure that is finer grained and more randomly oriented. (auth)

12147 THE TEMPERATURE DEPENDENCE OF THE VISCOSITY OF LIQUID METALS. Simon W. Strauss (Naval Research Lab., Washington, D. C.). Nuclear Sci. and Eng., 12: 436-9(Mar. 1962).

By combining the empirical formulas for the viscosity at the melting point and for the viscosity as a function of temperature (i.e., $\eta = A/T + B$), the constant B is eliminated. By fitting the resultant expression to experimental data for several metals, A is determined as a function of the melting temperature. Thus a function is obtained for η as a function of temperature, melting temperature, molecular weight, and atomic volume at the melting point. Errors range from about 10 to 30%. (T.F.H.)

12148 TERNARY SYSTEM Th–Ce–Al. J. H. N. van Vucht. Philips Research Repts., 16: 1-40(Feb. 1961).

Metallographic examination and x-ray analysis of Th-Ce-Al, Th-Al, Ce-Al, Th-Ce, and Ce were made. Data are given for structure, lattice constants, atomic sites, and composition. The structure of Ceto, a nonevaporating getter, is determined. (Rev. Metal Lit., 18: No. 9)

12149 THE PARAMAGNETIC SUSCEPTIBILITIES OF SOME URANIUM–MOLYBDENUM ALLOYS BETWEEN 100°K AND 300°K. B. S. Chandrasekhar and J. M. Bardeen (Westinghouse Electric Corp., Pittsburgh). Phys. and Chem. Solids, 21: 206-9(Dec. 1961). (In English)

Measurements of the paramagnetic susceptibilities of quenched γ-phase uranium–molybdenum alloys, containing 15–30 at. % molybdenum, in the range 100–300°K are described. The results are shown to be consistent with a decreasing density of states at the Fermi energy with increasing Mo concentration. This is in agreement with the results of specific heat measurements, and with the resistivity and Hall effect in these alloys. The temperature variation of the susceptibility can also be understood on the same basis. (auth)

12150 ON THE ELECTRONIC STRUCTURE OF LIQUID TRANSITION METALS AND CERTAIN COMPLEX PHASES. Y. A. Rocher and J. Friedel (Faculté des Sciences, Orsay, France). Phys. and Chem. Solids, 21: 287-94(Dec. 1961). (In French)

In the tight-binding approximation, the wave function of an electron is calculated for an isotropic metal structure. This model should apply approximately to liquid metals and to some complex crystalline structures of transition metals: αMn, βW, σ phases, and low and intermediate temperature phases of the actinides. Although somewhat rough, the model definitely predicts a very high electronic density at the Fermi level for a d band filled up to more than one-

third. These predictions are in fair agreement with experiment. They suggest that the high temperature superconductivity observed in some of those structures is due to a very high electronic density. (auth)

12151 THE WORK FUNCTION OF ZIRCONIUM CARBIDE. B. J. Hopkins and K. J. Ross (The University Southampton, Eng.). Proc. Phys. Soc. (London), 79: 447-8 (Feb. 1, 1962).

The zirconium carbide anode work function was measured, using the Zisman vibrating-condenser modification of the Kelvin technique. Molybdenum was used as the reference electrode material. The technique gives a measure of the true work function, assuming a uniform surface; an average function may be obtained for a patchy surface. (L.N.N.)

12152 RECENT ADVANCE IN THE METALLURGY OF REFRACTORY ALLOYS. R. Syre (Centre de Recherches Metallurgiques, Pechiney-Chambery, France). Rev. mét., 58: 1021-7(Dec. 1961). (In French)

Methods used in improving the high-temperature ductility, hardness, and strength of Nb, Mo, Ta, and W alloys are discussed. (D.E.B.)

12153 THE METALLURGY OF ZIRCONIUM. J. P. Givord. Rev. mét., 59: 23-34(Jan. 1962). (In French)

Discussion is given on the preparation of zirconium by the Kroll process checking metal purity, properties of zirconium and its alloys, and the influence of interstitial elements (O_2, N_2, H_2, C), substitutional elements (Al, Sn), transition metals (Nb, Ta), and isomorphs (Ti, Hf) on the properties, and the properties of the Zircaloys. Application of zirconium in atomic energy and chemical industries is also discussed. (auth)

12154 X-RAY DETERMINATION OF THE EXPANSION COEFFICIENTS OF HEXABORIDES. N. N. Zhuravlev, A. A. Stepanova, Yu. B. Paderno, and G. V. Samsonov (Moscow State Univ. and Inst. of Powder Metallurgy and Special Alloys, Academy of Sciences, Ukrainian SSR). Soviet Phys.-Cryst., 6: 636-8(Mar.-Apr. 1962).

Thermal expansion coefficients were determined for 19 hexaborides from x-ray patterns at temperatures up to 800°C. The specimens were prepared by reducing the oxides of the metals with boron. Initially, powder patterns were recorded at 20, 500, 600, 700, and 800°C. The lattice constants were found to vary linearly with temperature, within experimental errors; the error in α lies between 0.3 and 0.5×10^{-6} deg^{-1}, except for the hexaborides of Nd and Tb, for which the error is 10^{-6} deg^{-1}. Calculated melting points and parameters of 14 of the hexaborides are also given. The borides clearly have relatively small amplitudes of vibration, which are nearly the same for all, although the values for the metals differ widely. This shows that the boron is responsible for the main strength of the structure and that the metal plays the same part no matter what its valency. (P.C.H.)

12155 DETERMINATION OF MEAN DISLOCATION DENSITY IN DEFORMED MOLYBDENUM AND YTTRIUM. S. D. Gertsriken and B. F. Slyusar. Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S.S.R., Sbornik Nauch. Rabot, No. 13, 74-9(1961). (In Russian)

Dislocation density and microhardness as functions of metal deformation are plotted for molybdenum and yttrium. (R.V.J.)

12156 DIFFUSION PARAMETERS IN β PHASE OF Ti AND ITS ALLOYS WITH SMALL ADMIXTURE OF Fe, Co, AND Ni. S. D. Gertsriken, M. P. Pryanishnikov, and L. F. Slastnikova. Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S.S.S.R., Sbornik Nauch. Rabot, No. 13, 88-92(1961). (In Russian)

Diffusion of Fe, Co, and Ni in β phase titanium and its binary alloys with 4 at.% of Fe, Co, or Ni was studied at 800 to 1200°C. (R.V.J.)

12157 TERNARY Cr–Nb–Mo ALLOY. V. N. Svechnikov and G. F. Kobzenko. Voprosy Fiz. Metal i Metalloved., Akad. Nauk Ukrain. S.S.R., Sbornik Nauch. Rabot, No. 13, 115-17(1961). (In Russian)

Cr–Mo–Nb alloy was prepared by arc-melting under an argon atmosphere. An isothermal diagram was plotted at 1550°C. (R.V.J.)

12158 ELECTRON MICROSCOPIC INVESTIGATION OF VACANCIES IN QUENCHED CUBIC FACE-CENTERED CRYSTALS, ESPECIALLY IN NICKEL–COBALT ALLOYS. Siegfried Mader, Alfred Seeger, and Eberhard Simsch (Max-Planck-Institut für Metallforschung, Stuttgart and Technische Hochschule, Stuttgart). Z. Metallk., 52: 785-94(Dec. 1961). (In German)

The agglomeration of quenched-in vacancies in face-centered cubic Ni-Co, Ni-Cu, and Au was investigated by transmission electron microscopy. In Ni-Cu and Ni-Co up to 55% Co content only prismatic dislocation loops were observed. In Ni-Co with higher Co content stacking fault tetrahedra also occur. Tetrahedra form only in Ni-Co alloys of low stacking fault energy, where the total energy of a tetrahedron is less than the energy of a dislocation loop. The loops observed in this investigation cannot be formed by condensation of vacancies on {111}-planes and subsequent removal of the stacking fault by a Shockley partial. The nucleation of such a partial dislocation loop is only possible at stacking fault energies of the order of $\gamma \gtrsim 30 \times 10^{-3}$ G · b. In Ni and Ni-Co alloys the density of vacancy products visible in the electron microscope is rather low. This is thought to be due to the segregation of vacancies into small invisible voids. In ferromagnetic metals the conversion of spherical voids into dislocation loops is presumably rendered difficult by the magnetic stray fields. (auth)

12159 EXPERIMENTAL STUDIES ON THE MAGNETIC PROPERTIES AND PRECIPITATION KINETICS OF IRON–COPPER ALLOYS. Abdul Haq Qureshi (Rheinisch-Westfalische Technische Hochschule, Aachen). Z. Metallk., 52: 799-813(Dec. 1961). (In German)

The effects of heterogenous precipitates on coercive fields, the initial permeability, the specific resistance, and the Vickers hardness were examined on iron alloys with additions of Cu up to 2.14 wt. %. Besides, the form, the diameter of the precipitated particles and also the space density were determined in the course of the coagulation through electron microscope. To serve as a background for the studies the solubility of Cu in Fe was also determined. The theoretical data advanced to explain the kinetics of precipitation of undercooled mixed crystals were based in general upon the assumption that the number of particles, in the course of the precipitation, remained constant. Contrary to this it was found in the Fe-Cu system that the complete amount had already precipitated before the coercive field began to increase, and that all changes in the coercive field due to increase in the tempering were mainly caused by intense coagulation of the particles. During tempering the volume of the particles changed by more than three ten-exponents. According to the previous theoretical models, the measurement of the coercive field reaches its maximum at that moment when the diameter of the spherical precipitates reaches the thickness of the Bloch wall. The initial permeability falls even at very

short periods of tempering and remains almost constant, while the coercive field grows considerably during the coagulation. This behavior cannot be explained with the existing theories. The results were discussed in connection with the known theoretical data on the kinetics of precipitation. Although the coagulation of the particles was not considered, our case has yielded simple exponential laws for the relation between precipitation and time. Considering the particle size there is even an agreement between our results and the theoretical equations without making allowance for the coagulation. A less amount of Cu in the undercooled phase produced precipitates in the form of sticks whereas a high surplus produced almost spherical precipitates. (auth)

12160 THE ELECTRICAL PROPERTIES OF ENGINEERING NICKEL–CHROMIUM ALLOYS. Hans Thomas (Laboratorium der Vacuumschmelze A. G., Hanau, Ger.). Z. Metallk., 52: 813-16(Dec. 1961). (In German)

The electrical resistance and the thermo-electrical properties of Ni-Cr alloys used for heating conductors and thermo-couples depend largely on the preliminary treatment. A long annealing in the temperature range between 300 and 500°C, which might also occur during a slow cooling from high temperatures, leads to a considerably higher resistance than fast cooling or quenching from temperatures above 600°C. The thermo-electrical power is similarly influenced by different cooling rates and shows that the direction of change depends on the chromium content. The changes are of reversible nature and so far as is known cannot be removed. It is therefore important to take this behavior into consideration in the application of these alloys. (auth)

12161 THE IMPROVEMENT OF THE ELASTICITY PROPERTIES OF COPPER–ZINC ALLOYS BY ABNORMAL HARDENING. Heinrich Sebastian (R. & G. Schmöle Metallwerke, Menden, Ger.). Z. Metallk., 52: 825-30(Dec. 1961). (In German)

Investigations of α Cu-Zn alloys have shown that by a reasonable heat-treatment the spring-bending-limit σ_{bE} can be considerably increased. As the result of a suitable thermal refinement of about 50 to 75% cold-rolled 70 : 30 brass the σ_{bE}-values exceed that obtained from a non-heat-treated state by 40 to 100%. Tempering curves of the spring-bending-limit show that a very accurate observation of temperature and time is necessary during quench-aging and that a slight deviation from the optimal conditions may cause this effect to disappear. In the cold-worked state the spring-bending-limit is strongly dependent on the orientation of the sample to the deformation direction. Through a sutiable heat treatment the differences due to the orientation may, to a great extent, be compensated. With increasing deformation the spring-bending-limit increases evenly in an orientation perpendicular to the direction of rolling. In the case of an orientation parallel to the direction of rolling the spring-bending-limit cannot be longer increased by cold-working above a deformation of about 75%. The cause of this abnormal hardening should be found in a structural process for which the activation energy is determined to be 40 kcal/mol. (auth)

12162 NICKEL–RUTHENIUM ALLOYS. Ernst Raub and Dorthea Menzel (Forschungsinstitut für Edelmetalle und Metallchemie, Schwäbisch Gmünd, Ger.). Z. Metallk., 52: 831-3(Dec. 1961). (In German)

The equilibrium diagram of the system Ni-Ru was investigated by a combination of thermal, microscopic, and x-ray methods. Ni-Ru alloys show a peritectic reaction with a largely extended field of solid solution at the peritectic temperature. The solubility curve of the Ru-rich solid solutions shows a slight retrograding. Between the peritectic temperature (1490°) and 600° the solubility curve of the Ni-rich phase drops from 29.7 at. % Ru (42.2 wt. %) to 3.1 at. % Ru (6.2 wt. %). In the same temperature range the solubility curve of the Ru-rich phase drops from 48.7 at. % Ni (35.4 wt. %) to 7.2 at. % Ni (4.5 wt. %). In the field of Ni-rich solid solution the hardness is considerably increased with increasing Ru content. Alloys with a maximum content of 30 at. % Ru (42.5 wt. %) are easily deformable by cold-rolling and cold-forging. The deformability decreased markedly with higher Ru contents. (auth)

12163 THE STICKING OF NIOBIUM, TITANIUM, AND ZIRCONIUM TO HARDNESS TESTING DIAMONDS. Kuno Kirner (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 52: 836-7(Dec. 1961). (In German)

Sticking of material on diamond indenters in hardness testing of niobium, titanium, and zirconium is reported. It is assumed that the high affinity of these metals to carbon is causing the sticking. (auth)

12164 DIFFUSION OF Kr-85 IN ThO_2. Hansjoachim Matzke (Tekniska Hogskola, Goteborg). Z. Naturforsch., 16a: 1255-7(Nov. 1961). (In German)

As a corollary to the study of the diffusion of I^{131}, Xe^{133}, and Rn^{222} in ThO_2, the diffusion of Kr^{85} in ThO_2 was measured. The results of these measurements are shown graphically and discussed. (J.S.R.)

12165 ON THE "HELICAL" ANTIFERROMAGNETISM OF GADOLINIUM. K. P. Belov and A. V. Pedko (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 87-90 (Jan. 1962). (In Russian)

Magnetic properties of Gd in weak fields are measured. The magnetization drops sharply at temperatures from Θ_1 = 210°K to the Curie point Θ_2 = 290°K. Sharp breaks observed in magnetization isothermals $\sigma(H)$ are similar to those observed in dysprosium at critical fields corresponding to destruction of helical antiferromagnetism. It is suggested that a helical spin structure exists in gadolinium at temperatures between Θ_1 and Θ_2. However, application of very weak fields ($H_K \sim 0$–15 gauss) is sufficient to destroy this structure. (auth)

12166 HEAT CAPACITY OF Ni_4W AT HIGH TEMPERATURES. Z. V. Proshina and T. N. Rezukhina (Moscow State Univ.). Zhur. Fiz. Khim., 36: 153-5(Jan. 1962). (In Russian)

The mean heat capacity of Ni_4W over the range 293 to 1100°K was measured by mixing in a massive metallic calorimeter. The following equation was derived for the temperature dependence of the true heat capacity of Ni_4W: $C_p = 25.70 + 11.14 \times 10^{-3}T$. (auth)

12167 THERMAL CAPACITY OF NiAl INTERMETALLIC COMPOUNDS FOLLOWING THERMAL TREATMENTS. V. A. Troshkin and K. G. Khom'yakov. Zhur. Neorg. Khim., 6: 2433-5(Nov. 1961). (In Russian)

The heat capacity of intermetallic NiAl was measured following various thermal treatments. It was found that at temperatures exceeding 600°C the compound suffers partial disintegration forming defective structures. The behavior of alloys containing 68.8 and 67.7 wt % Ni was identical. The energy behavior of annealed NiAl and Fe–Ni–Al was also identical. (R.V.J.)

12168 EFFECTS OF CARBON ON TITANIUM CARBIDE SOLUBILITY IN COBALT AND PROPERTIES OF Ti–C–Co ALLOYS. A. V. Rybal'chenko, I. N. Chaporova, and V. I. Tret'yakova. Zhur. Neorg. Khim., 6: 2517-27(Nov. 1961). (In Russian)

Microstructure analysis indicated that titanium carbide solubility is determined by the content of hydrocarbon in the melting and sintering processes. With hydrogen saturation in the melt and TiC saturation in cobalt, the eutectics of TiC + C + Co does not exceed 0.2% TiC. With reduced hydrogen, TiC slowly increases and reaches 5 wt %. X-ray diffraction, microstructure, and thermal analysis data are tabulated. (R.V.J.)

12169 CONSTITUTION DIAGRAM OF Nb–Pd ALLOYS. E. M. Savitskii, V. V. Baron, and A. N. Khotinskaya (Inst. of Metallurgy, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 2603-5 (Nov. 1961). (In Russian)

The constitution diagram of Nb–Pd alloy was constructed on the basis of physicochemical analysis; 99.9% pure Pd and 99.5% pure Nb were used. Two compounds were observed; Nd_2Pd with a σ-phase tetragonal lattice which crystallized at 1650°C and Pd_3Nb which formed at 1700°C. Small additions of Nb increase the hardness and strength of Pd alloys and reduce the temperature coefficient of electric conductivity, but do not effect the magnitude of the specific electric conductivity. (R.V.J.)

12170 PHASE DIAGRAM OF TERNARY Ni–Cr–W–Al AT 1100°C. S. P. Alisova, P. B. Budberg and K. I. Shakhova. Zhur. Neorg. Khim., 6: 2607-9 (Nov. 1961). (In Russian)

Three phase diagrams were constructed for Ni–Cr–W–Al alloys (40% Cr and 30% W + Al) at 1100°C. The properties of the alloy were analyzed. (R.V.J.)

12171 INVESTIGATIONS OF Ti–Cr–C SYSTEMS WITH 20% Cr AND 1% C. N. N. Kurnakov and M. Ya. Troneva. Zhur. Neorg. Khim., 7: 157-64 (Jan. 1962). (In Russian)

Thermal and microstructure analyses were made of Ti–Cr–C containing up to 20% Cr and 1.0% C and annealed at 1100, 800, and 700°C. The results show that carbon increases the temperature of the eutectoid transformation. The isothermal cross sections are plotted for 1100, 800, and 600°C. (R.V.J.)

12172 MULTI-LAYER SHEET MATERIAL IMPERVIOUS TO RADIOACTIVE LIQUIDS. Wilhelm Ernst (to Papierfabrik Wilhelmstal Wilhelm Ernst). British Patent 890,737. Mar. 7, 1962.

A multi-layer sheet material may be fabricated which can be used as covering for laboratory equipment, wall covering, and wrappings such as hoods and overshoes. The sheet material can also be built up into packages to protect packed articles from radioactive liquids or to contain radioactive waste materials for eventual disposal. The material comprises four layers: absorbent paper, paraffin wax, gummed paper, and polyvinyl chloride foil. (D.L.C.)

12173 BRAZING ALLOY. (to U. S. Atomic Energy Commission). British Patent 890,971. Mar. 7, 1962.

A brazing alloy is described for making leak-proof bonds of Zr or an alloy thereof to one of the materials Zr, Zr alloys, Fe, C, steel, stainless steel, U, ceramics, and cermets. The brazing alloy consists of 6 to 9 wt% Ni; 6 to 9 wt% of Cr, Mo, or W; 0 to 7.5 wt% Fe; and the balance Zr. One preferred composition is 8 wt% Ni, 8 wt% Cr, and balance Zr, and another preferred composition for brazing Zr to Fe is 6 wt% Ni, 6 wt% Cr, 6 wt% Fe, and balance Zr. Three examples are given for the use of the brazing alloy in Zr-clad reactor fuel elements and heat exchanger headers. (D.L.C.)

Radiation Effects

Refer also to abstracts 11771, 12283, 12666, and 12703

12174 (54GL213) BIBLIOABSTRACT ON RADIATION EFFECTS. J. W. Ryan and W. R. Langdon (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Aug. 2, 1954. 134p. (BA-75)

An annotated bibliography is presented, consisting of 528 references to material on radiation effects on physical, electrical, chemical, mechanical, thermal, optical, metallurgical, and biological properties of matter. A subject index is included. (T.F.H.)

12175 (CERN-62-5) RADIATION DAMAGE OF SEMICONDUCTORS BY PROTONS. G. Backenstoss, E. Braunersreuther and K. Goebel (European Organization for Nuclear Research, Geneva). Jan. 24, 1962. 24p.

Ge and Si pnp and npn transistors and InAs and InSb Hall plates are exposed to proton irradiations at 550 to 600 Mev. The Hall plates are also exposed to 4-Mev protons. The transistor current amplification is affected at exposures of about 10^{12} protons/cm^2, and decreases to about 10% of its original value at 10^{13} protons/cm^2. At 10^{15} protons/cm^2 at 4 Mev, the minority carrier concentrations and mobilities in the Hall plates begin to be affected. Mobility losses as great as 90% are observed. (T.F.H.)

12176 (DP-662) PRELIMINARY IRRADIATION OF FUSED UO_2. G. Rolland Cole (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Jan. 1962. Contract AT(07-2)-1. 29p.

Four swaged rods of fused UO_2 sheathed in stainless steel were irradiated to burnups ranging from 1580 to 3390 Mwd/T at relatively low powers ranging from 3.7 to 7.9 kw/ft without external damage or dimensional changes. The sheaths were punctured to collect and measure the released fission gases, but nitrogen and carbon dioxide were the chief constituents of the gas collected. The two kinds of uranium oxide tested, with oxygen-to-uranium ratios of 2.087 and 2.132, did not differ appreciably in fission gas release and in the appearance of fuel cross sections. Lack of central grain growth indicated that the maximum fuel element temperatures were less than 1500 to 1700°C. (auth)

12177 (HW-65465) HYDRIDING IN PURPOSELY DEFECTED, ZIRCALOY-CLAD FUEL RODS. M. K. Millhollen, G. R. Horn, and J. L. Bates (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1961. Contract AT(45-1)-1350. 35p.

Information is presented on hydrogen absorption in zirconium alloys, as revealed by six irradiation tests of purposely defected, Zircaloy-clad, UO_2 fuel elements. Both Zircaloy-2 and Zircaloy-4 (nickel-free Zircaloy-2) were used as cladding materials. Results of these tests indicate that Zircaloy-4 has a much higher resistance to hydriding than does Zircaloy-2. (auth)

12178 (KAPL-2159) ANNEALING OF REACTOR RADIATION DAMAGE IN LEAD AND BISMUTH TELLURIDES. J. C. Corelli, R. T. Frost, and D. M. Amorosi (Knolls Atomic Power Lab., Schenectady, N. Y.). July 3, 1961. Contract W-31-109-Eng-52. 75p.

Reactor irradiations of specimens of n-type and p-type lead and bismuth tellurides were carried out to neutron doses of 5×10^{19} fast (E > 1 Mev) neutrons/cm^2 and 6×10^{20} thermal neutrons/cm^2 at an irradiation temperature of 60 ± 20°C. Comparison of pre- and postirradiation electrical properties of duplicate specimens irradiated with and

without cadmium shields indicated that, for these exposures, the principal damage is caused by fast neutrons. This confirmed earlier results obtained from similar specimens irradiated to fast and thermal neutron doses one-quarter as great. Comparison of the results of the two experiments indicated that damage caused by fast neutrons tends to saturate at a dose of 1 to 2×10^{19} fast neutrons/cm^2. Hall coefficient data indicated that the major portion of damage to electrical and thermal conductivity and Seebeck coefficient of n-type PbTe could be attributed to depression of electrical carrier concentration. This is tentatively attributed to a bombardment-induced trapping level 0.037 volts below the bottom of the conduction band. Annealing experiments performed with the irradiated n-type PbTe indicated complete recovery of measured properties for the cadmium-shielded specimen at temperatures in the range of 140 to 200°C. Small unannealable changes in electrical properties of the unshielded specimen were, within experimental and calculational uncertainties, attributable to increases in carrier concentration caused by transmutation-induced increases in iodine doping level. Similar results were obtained in the case of n-type Bi_2Te_3. Damage to p-type PbTe was not completely removed by annealing. Cold-work experiments carried out on this brittle material indicated that the unannealed damage may be caused by effects associated with the encapsulation procedures. The largest changes in electrical properties before annealing were observed in the case of the initially undoped p-type Bi_2Te_3, in which Seebeck and Hall coefficients showed a reversal in sign as a result of the irradiation. (auth)

12179 (KAPL-2169) CHARACTERISTICS AND ANNEALING OF NEUTRON-IRRADIATED PbTe. J. C. Corelli and D. M. Amorosi (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 25, 1961. Contract W-31-109-eng-52. 43p.

Electrical conductivity and Hall and Seebeck coefficient changes of n-type PbTe were extended to reactor irradiations of 10×10^{19} cm^{-2} neutrons with energy greater than 1 Mev and thermal neutron doses of 10^{21} cm^{-2}. Similar properties were measured for extruded p-type PbTe after reactor irradiations of 10^{19} cm^{-2} for fast neutrons and 3×10^{20} cm^{-2} for thermal neutrons. Sample temperatures during irradiation were 60 ± 20°C. Isothermal annealing experiments indicated the simultaneous recovery of conductivity and Hall and Seebeck coefficients from 100 to 170°C and from 140 to 180°C for p- and n-type materials, respectively. The carrier concentration decrease for the p-type PbTe (factor 5.7) accounted for most of the increase in Seebeck coefficient (factor 2.1). An analysis of the annealing of conductivity (increased by factor 17) for the p-type PbTe data yielded an activation energy of 1.3 ± 0.1 ev. For n-type PbTe, the analysis of both conductivity (increased by factor 12) and Hall coefficient (increased by factor 4.6) yielded an activation energy of 1.3 ± 0.1 ev. The decrease of the carrier concentration could be attributed to a bombardment-induced trapping level 0.026 ± 0.003 ev below the bottom of the conduction band. The carrier concentration decrease accounted for most of the increase in Seebeck coefficient (increased by factor 1.9). In the annealing process for both materials, there was evidence of a second stage that appeared at low temperature in the p-type and at high temperature in the n-type. After annealing, both materials retained their characteristic band gaps of ≈0.32 ev. The irradiated and annealed n-type PbTe exhibited a mobility temperature dependence of $T^{-3/2}$, which was the same as that found for unirradiated material. Small permanent changes caused by transmutations, and comparisons with previous irradiations at lower doses, which indicated a saturation in the radiation damage, are discussed. (auth)

12180 (NAA-SR-193) PULSE-ANNEALING OF RADIATION ANNEALED HANFORD GRAPHITE SAMPLES. A. S. Hook (North American Aviation, Inc., Downey, Calif.). Oct. 27, 1952. Contract AT-11-1-GEN-8. 19p.

The results of the pulse-annealing of Hanford radiation-annealed specimens of AGOT-CSF type graphite are presented. Radiation annealing is shown to be considerably more effective than thermal annealing alone in reducing the damage-induced change in thermal resistivity and thermoelectric power. The electrical resistivity is relatively insensitive to radiation annealing for the exposure histories studied. The thermal resistivity of the radiation damaged graphite is found to return to a value below its original preirradiation value following thermal annealing. A 30% decrease is indicated in the thermal resistivity following radiation damage and subsequent thermal annealing at 2200°C, as compared with the preirradiation value. (auth)

12181 (TID-15041) PROGRESS REPORT [ON X-IRRADIATED CRYSTALS, IONIC CONDUCTIVITY OF NaCl AND RADIATION DAMAGE TO Cu]. [Nebraska. Univ., Lincoln]. Feb. 1, 1962. Contract AT(11-1)-525. 54p.

Studies were carried out to determine if there is any transient stage of F-center production which can be affected by quick bleaching. Crystals were simultaneously irradiated with x rays and with light and compared with those which were x rayed in the dark. The crystals which were harder to color exhibited the phenomenon that irradiating with x rays and white light at the same time predisposed them to higher colorations on subsequent irradiation in the dark, than if they were irradiated in the dark all the while. A mechanism for this effect is proposed. Experimental runs were undertaken in which copper foil samples were bombarded with protons in the energy range from 50 to 350 kev to show reproducibility of the experimental data. Results indicated that at present the data is not reproducible. Reasons for this are discussed. Work was continued in an effort to detect and measure the non-linearity in the ionic conduction of solids. Measurements of the contribution of the cubic term in the applied field to the total current were made in a number of NaCl specimens as a function of the specimen temperature and the applied field. The magnitude of the cubic term was found to be about 800 times that predicted by simple ionic conductivity theory. (M.C.G.)

12182 (TID-15122) SOFT X-RAY IRRADIATION TECHNIQUES. RESONANCE IN RADIATION EFFECTS. Technical (Progress) Report No. 3. Henry J. Gomberg, Marvin C. Atkins, William R. Clendenning, and Adon A. Gordus (Michigan. Univ., Ann Arbor. Michigan Memorial-Phoenix Project). Dec. 1961. Contract AT(11-1)-684. 60p. (ORA-3049-3-P)

Studies are being made of the energy dependence of radiation damage in the soft x ray region, from 5 to 40 kev. Methods for the production of monochromatic radiation in this region are described. Principles of operation and resolution of a high-output Bragg Spectrometer are discussed. Principles of the use of x-ray fluorescence are outlined. Techniques for the use of x-ray fluorescence as a radiation source are described. (M.C.G.)

12183 (UCRL-9845) COLOR PRODUCTION FROM ENERGETIC IONS IMPINGING ON METALS. Kenneth W. Ehlers (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1961. Contract W-7405-eng-48. 29p.

It was observed that energetic ions, such as those of oxygen and nitrogen, mark with color the region of their im-

pingement on certain metals. The effect was first observed when, under the same conditions of bombardment, different multicharged ions of the same gas marked their impact areas with different colors. In the energy region of this investigation (approximately 5 to 50 kev) these colors ranged through the visible spectrum from violet to red. The colors seem sensitive to the type and energy of the ion as well as to the metal bombarded. It is possible that the colors are the result of reflections from thin films formed by reactions with the ion at the target. As the colors indicated that thicker films are produced as the ion energy is increased, a comparison was made between the depth of ion penetration as predicted by range-energy theory and the depth indicated by the colors observed. Metals were bombarded with helium ions with somewhat similar results. Useful applications for this effect are discussed. (auth)

12184 (VDIT-16(Ind.61)) RADIATION EFFECTS ON SOLID, URANIUM-BASED NUCLEAR FUEL MATERIALS. Cumulative Coordinate Index to the Bibliography for the Year 1961. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Dec. 1961. 15p.

12185 (WT-1139) RADIATION EFFECTS ON SELECTED COMPONENTS AND MATERIALS. James B. Graham and J. A. Biggerstaff (Army Signal Engineering Labs., Fort Monmouth, N. J.). Aug. 16, 1957. Project 6.2 [of] Operation TEAPOT. 20p.

This project was implemented to study the performance of selected Signal Corps components and materials, either in use or storage, after being subjected to the intense radiation from a nuclear device. It is essential to know both the reliability of present components under such conditions and the types of failures that occur after irradiation. This knowledge is useful as background for the development of new components and materials, and in evaluating the usability of stocks of present types of equipment in the event that they are subjected to intense radiation without sustaining blast or thermal damage. Several stations were set up at distances which resulted in exposures of 4×10^4 roentgens or higher. Since the ratios of gamma exposures to over-pressures vary in the range of interest, participation was limited to events of comparatively large yield. Performance characteristics of each component were measured both prior to and after exposure. There was no noticeable interference with the normal functioning of the radar beacon or the electron tubes. In the case of the quartz crystals, measurable effects were noted. Further laboratory testing is necessary in order to assess that portion of the frequency shift which may have been caused by irradiation, as opposed to purely mechanical effects. (auth)

12186 (NP-tr-861) THE PRODUCTION OF RADIATION DEFECTS CONSIDERED FROM THE POINT OF VIEW OF ENERGY RELATIONS. M. Balarin and O. Hauser. Translated by M. Archer (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Kernenergie, 3: 973-8(Oct.-Nov. 1960). 24p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 7859.

12187 IONIZING RADIATION, PARTICULARLY REACTOR RADIATION, AS AUXILIARY IN THE INVESTIGATION OF SOLID MATERIALS. H. G. van Bueren. Atoomenergie, 3: 251-60(Dec. 1961). (In Dutch)

The basis of experimental irradiation techniques, the theoretical background of the formation of lattice faults, the nature of the faults, and the "reaction" which can occur between these faults are described. Examples are given of the effects of structural changes on the physical and mechanical properties. (tr-auth)

12188 EFFECT OF NUCLEAR RADIATIONS ON THE ELECTRONIC PROPERTIES OF SEMICONDUCTORS. Nguyen Van Dong. Bull. inform. sci. et tech. (Paris), No. 56, 28-38(Nov. 1961). (In French)

The study of damage caused to semiconductors by radiations is reviewed. Two aspects of the problem are approached: the mechanism of the creation of defects in a crystal lattice under the action of bombardment and effects on the electronic properties. The problem of neutron dosimetry in a reactor is also discussed. (auth)

12189 INFLUENCE OF F-CENTER CONCENTRATION ON THE ELECTRIFICATION OF THE DUST OF KCL MONOCRYSTALS IRRADIATED WITH β RAYS. Jan Nikliborc (Univ. of Wroclaw, Poland) and Anna Szaynok. J. Appl. Phys., 33: 613-15(Feb. 1962).

The electrification of the dust of KCl monocrystals irradiated with β rays is influenced by absorption of electrons in the crystal, creation of F centers, and secondary emission. The F-center concentration in crystals irradiated with β rays for various irradiation times was measured spectrophotometrically. Based on the F-center model and using statistical calculations, the relationship between the F-center concentration in the crystal and the surface charge due to F centers was found. (auth)

12190 MECHANISM FOR DISLOCATION PINNING IN THE ALKALI HALIDES. Charles L. Bauer and Robert B. Gordon (Yale Univ., New Haven). J. Appl. Phys., 33: 672-82(Feb. 1962).

Changes in the elastic modulus and internal friction of plastically deformed rocksalt, caused by changes in the mean free length of oscillating dislocation segments, were observed during x-irradiation at 10 to 300°K. The rates at which the modulus and damping changes occur during irradiation are independent of temperature; but during irradiation at helium temperature, the magnitude of the effects are smaller. This decrease in magnitude is due to the absence of thermal unpinning. Explanations of the pinning process based on the diffusion of point defects to dislocations appear to be ruled out by the rapidity of the low temperature modulus change. The dislocation pinning produced by irradiation of NaCl, KCl, KBr, and KI at low temperatures is reversible when the crystals are subjected to illumination in, or near, the visible. The wavelength of the illumination that produces the maximum unpinning increases as the lattice constant increases; the effect disappears when the crystals are warmed to room temperature. However, at all temperatures, bleaching a deformed and partially irradiated crystal with F light causes a further modulus increase. The pinning point produced by low temperature irradiation is identified as a dislocation jog in close association with an F center whose absorption band is displaced toward the red by the dislocation strain field. Ionization of the F center results in recombination of its vacancy with the jog; warmup allows the F center to diffuse beyond recombination range. (auth)

12191 ETCHING OF IRRADIATED COPPER. F. W. Young, Jr. (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 33: 749-50(Feb. 1962).

Copper crystals with (111) surfaces and low dislocation density were irradiated using fast neutrons at room temperature and were stored until the induced radioactivity decayed. A dislocation etch was applied, and the etch pits and background surface structure were observed directly, using an optical microscope and preshadowed carbon rep-

lication with an electron microscope. No sensible change in dislocation density or arrangement resulted from the irradiation. The background structure of the surface between the old dislocations was different after irradiation and etching. For a crystal irradiated by 6×10^{16} neutrons/cm^2, the background structure was only slightly different from that of annealed crystals. Few loops at ~150 Å would be produced in this case. (L.N.N.)

12192 THE RELEASE OF STORED ENERGY FROM NEUTRON-IRRADIATED URANIUM OXIDES. B. G. Childs (Dounreay Experimental Reactor Establishment, Caithness, Scotland). J. Nuclear Materials, 5: 128-39(Jan. 1962). (In English)

The release of stored energy from uranium oxides irradiated with up to 1.1×10^{19} n/cm^2 was studied over the range 50 to 700°C using a sensitive differential calorimeter. Little, if any, energy release could be detected for single phase UO_2 and U_4O_9 specimens but a small peak was found, at about 340°C, for two phase specimens of composition $UO_{2.01}$. For U_3O_8 a major energy release peak was found at a temperature which varied, with exposure, from 150°C for 6×10^{15} n/cm^2 to 380°C for 1.1×10^{19} n/cm^2. The total energy released increased with exposure up to a saturation value of 25.5 cal/g at 1.4×10^{17} n/cm^2. These results are discussed in terms of a model in which a region of homogeneous and saturated disorder is associated with the passage of each fission fragment through the material. The volume of this region is, on the average, 2.7×10^{-16} cm^3. (auth)

12193 EFFECT OF TEMPERATURE DURING IRRADIATION ON THE BEHAVIOUR OF HELIUM IN ALUMINIUM. C. E. Ells (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nuclear Materials, 5: 147-9(Jan. 1962). (In English)

The introduction of helium into metals by cyclotron alpha-particle irradiation is a particularly useful technique for determining vacancy sources in metals and understanding of inert-gas-bubble growth in general. The results given show that irradiation at elevated temperatures, as compared to low-temperature irradiation followed by heating, had no distinct effect on intragranular bubble growth but did result in enhanced growth of bubbles at grain boundaries. An example of helium bubble growth in aluminum irradiated at less than 50°C and subsequently heated for one hour at 500°C is presented. The enhanced bubble growth at grain boundaries can be explained on the assumption that the grain boundaries are highly preferred points of nucleation. Thus, helium moves to the grain boundaries from nearby regions, whereas on post-irradiation heating the intragranular material is so supersaturated that bubbles grow at once on less preferred nucleation points as well as at grain boundaries. Therefore, the location of helium-filled bubbles in neutron-irradiated beryllium will be dependent on metal temperature during irradiation. (N.W.R.)

12194 THE USE OF PRECIPITATION-HARDENED MATERIALS IN RADIATION FIELDS. G. R. Piercy (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nuclear Materials, 5: 158-9(Jan. 1962). (In English)

The added strength arising from precipitate particles in a metal may allow the use of thinner sections to conserve neutrons in reactors. However, fast neutron irradiation is known to have three effects on precipitation-hardenable alloys. If any of these reduce the hardening effect of the particles, the alloy is of doubtful use. The first effect is the additional precipitation caused by radiation-enhanced diffusion. The precipitation is only detectable in samples quenched to retain all the solute atoms in solution and the particles formed as a result of irradiation have a radius less than 10 Å. The second effect is the dissolution of already existing precipitate particles by displacement spikes. However, experiments show that only particles with radii less than about 12 Å were dissolved by fast neutron irradiation. The last effect increases the strength of the alloy by severely distorting its crystal lattice. It is shown that radiation can convert these large coherent particles into incoherent particles that do not appreciably distort the lattice since they have their own equilibrium crystal structure and are surrounded by a grain boundary. The effect, is severely reduced when the radiation causes the particle to lose coherency with the matrix. The hardening effect is illustrated by the copper-2 wt % cobalt alloy. (N.W.R.)

12195 EFFECT OF HIGH ENERGY RADIATION ON THE SURFACE OF SOLID BODIES. N. Riehl (Technische Hochschule, Munich). Kerntechnik, 3: 518-21(Dec. 1961). (In German)

Experiments on the radiation effects caused by high energy particles (α particles, heavy recoil atoms, and uranium fission products) at the surface of metals are reported. The purpose of the work was to contribute to research on the general problem of radiation damage in solids. Electron microscopy revealed no spikes or "craters" on the surface after irradiation. But another unexpected effect was observed after irradiation with α particles. The α bombardment caused a "smoothing" (diminution of roughness) of the metal surface. A possible explanation of this effect is discussed. A "cold sintering" of pressed powders by strong irradiation (i.e., a binding of the grains together at room temperature) was observed. The sputtering effect increased strongly with the mass of the high energy particle. One recoil atom from ThC "shoots away" from a gold surface about 100 Au atoms. A fission product can produce about 1000 sputtered Au atoms. (auth)

12196 THE EFFECT OF IONIZING RADIATION ON THE ADSORPTION AND CATALYTIC PROPERTIES OF SEMICONDUCTORS. F. F. Vol'kenshtein (Inst. of Physical Chemistry, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 481-9(July-Aug. 1961). (In Russian)

The mechanism of radiation effects on adsorption equilibrium, adsorption kinetics, and the rate of catalytic reaction is analyzed within the limits of the electron theory of chemosorption. An analysis is also made of the radiation effect as functions of temperature, pressure, and the composition of the specimen. (R.V.J.)

12197 ACTION OF NEUTRON IRRADIATION ON REFRACTORY COMPOUNDS AND POWDER METALS (REVIEW). V. V. Pen'kovskii (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., No. 5, 74-9(Sept.-Oct. 1961). (In Russian)

A survey is made of data on the effects of neutron irradiation of high melting compounds and cermets. It is shown that carbides and borides have higher resistance to neutron irradiation than their corresponding metals. This is observed best in uranium carbide fission. (R.V.J.)

12198 ELECTRON SPIN RESONANCE IN NEUTRON-IRRADIATED POLYCRYSTALLINE BERYLLIUM OXIDE. G. J. Troup and J. R. W. Thyer (Weapons Research Establishment, Salisbury, South Australia and Monash Univ., Clayton, Victoria, Australia). Proc. Phys. Soc. (London), 79: 409-15(Feb. 1, 1962).

Electron spin resonance, presumably from electrons or

holes bound to appropriate vacancies, was detected in neutron-irradiated polycrystalline BeO. A study of the behavior of the intensity and line-shape of the electron spin resonance signal with increasing radiation dose and on annealing was made. Considered as an anisotropic line, the electron spin resonance signal prior to annealing has approximately $g_{||} = 2.0036 \pm 0.001$, $g_{\perp} = 2.0110 \pm 0.001$. The change of line-shape of the electron spin resonance signal after annealing indicates that the initial signal may come from more than one type of spin center. (auth)

12199 UNUSUAL EFFECTS IN THE X-RAY PATTERNS OF IRRADIATED AND DEFORMED MONOCRYSTALS OF LiF. E. V. Kolontsova and I. V. Telegina (Moscow State Univ.). Soviet Phys.-Cryst., 6: 614-15(Mar.-Apr. 1962).

The diffuse scattering pattern given by a fixed crystal with monochromatic Mo Kα radiation shows curved and fairly sharp lines whose symmetry corresponds to that of the Laue pattern. The lines are double and stronger than the background on the convex side (toward the primary beam), whereas on the other side, they are weaker than the background. The contrast depends on the deformation, and the lines are best seen for doses of 10^{19} n/cm^2. The effect is ascribed to dynamic-scattering effects in damaged crystals. (P.C.H.)

12200 MEASUREMENT OF THE REDUCED PLASMA LOSS IN LITHIUM UNDER PENETRATING IRRADIATION. Helmut Fellenzer (Universität, Munich). Z. Physik, 165: 419-38(1961). (In German)

With an electronically recording sector spectrometer, characteristic energy losses in lithium under penetrating irradiation were measured. In thin lithium layers, in addition to the loss line at 8 ev, a new loss line occurs at 4.6 ev. It was shown qualitatively that with increasing layer thickness the new loss line relative to the 8-ev loss was smaller and that in equal layers the line was larger relative to the 8-ev loss with increasing beam voltage. In the conversion of lithium into lithium hydroxide, the 8-ev and 4.6-ev loss lines simultaneously disappear in the residual gas of the apparatus. The 4.6-ev loss also does not originate from LiOH being formed. It shows the behavior of the reduced plasma loss (lowered line) predicted by Ritchie. The 8-ev loss originates therefore from a plasma loss. Measurements of the intensity dependence on the angle gave, for the 8-ev loss, the behavior of a plasma loss as Ferrell calculated it. For the 4.6-ev loss, the angular behavior of a reduced plasma loss, which Stern and Ferrell have treated, was found. (tr-auth)

12201 GAMMA EFFECTS ON WETTABILITY OF MINERALS. A. K. Kikoin, B. P. Afanas'ev, G. V. Buresh, and A. E. Buzynov (Inst. of Metal Physics, Academy of Sciences, USSR). Zhur. Fiz. Khim., 36: 237(Jan. 1962). (In Russian)

Gamma radiation effects on the wettability of mineral rocks was analyzed in a 22-Mev betatron. The obtained data show considerable changes in the boundary angles on semiconductors and dielectric materials after 1000-r doses. Doses of 2000 and 3000 r did not enhance the effect and in some cases reduced it. (R.V.J.)

12202 EFFECT OF GRAIN SIZE, RATE OF STRAIN AND NEUTRON IRRADIATION OF THE TENSILE STRENGTH OF ALPHA-IRON. J. D. Campbell and J. Harding. p.57-76 of "Response of Metals to High Velocity Deformation." v. 9. Metallurgical Society of AIME. New York, Interscience Publishers, Inc., 1961.

A review of previous investigations and explanation of results in terms of dislocation theory are given. Impact apparatus for tensile testing at strain rates of 10^3 per sec is used to obtain dynamic stress-strain curves for specimens of pure Fe and 0.21% carbon steel in both unirradiated conditions and after different doses of neutron irradiation. Data are given for effects of grain size and strain rate on lower yield stress, and brittle behavior elongation to fracture. (Rev. Metal Lit. 18: No. 9)

PHYSICS

General and Miscellaneous

12203 (AD-260660) THERMOELECTRIC MODULE IMPROVEMENT PROGRAM. Report No. 1. (Westinghouse Electric Corp. New Products Labs., Cheswick, Penna.). July 1, 1961. Contract NObs-84329. 159p.

A summary is presented concerning improvements in the area of thermoelectric modules. Primary emphasis is placed on defining problems which require solution before thermoelectric generators can be built with required performance characteristics and reliability for military uses. A major section is also devoted to generator design for use in reactors. (J.R.D.)

12204 (AD-261673) CONSERVATION PRINCIPLES IN MULTIVELOCITY ELECTRON FLOW. Gunnar Hok (Michigan. Univ., Ann Arbor. Electron Physics Lab.). June 1961. Contract DA-36-039-SC-78801. 30p. (ORA-2900-265-T; EPL-TR-45)

The extension of Poynting's theorem to an electron gas with a continuous distribution of velocities is considered. In particular, an extension of the concept of kinetic potential is attempted, since this concept has proved itself very useful in the investigation of single-velocity flow. It is found that in three dimensions the electrokinetic flow vector cannot be expressed as the product of the convection-current density and a single scalar quantity of the dimension potential. In one-dimensional applications, however, this circumstance is immaterial. Another difficulty is encountered when a small perturbation component on a steady state is considered. The nonlinear Boltzmann transport equation gives a linear equation between the first-order perturbations, but the nonlinearity makes possible a conversion of part of the perturbation power flow to d-c power flow. In other words, the power flow associated with a single-frequency perturbation is not necessarily conserved in multivelocity flow, even in the absence of an a-c Poynting vector. (auth)

12205 (AFCRL-282) POTENTIAL DISTRIBUTIONS IN A LOW PRESSURE THERMIONIC CONVERTER. Scientific Report No. 4. Peter L. Auer (General Electric Co. Research Lab., Schenectady, N. Y.). July 1960. Contract AF19(604)-5472. 27p. (AD-260360)

A planar diode model of a low-pressure cesium-filled thermionic converter is examined. It is assumed that all ions and electrons are created at the surface of the hot cathode with a Maxwellian distribution corresponding to the cathode temperature. The charge species are then assumed to move through the plasma consisting of electrons, ions, and neutral cesium atoms as free particles under the influence of their mutual space charge field. A method is outlined by which the potential distributions corresponding to different operating conditions may be calculated completely. In this fashion the operating characteristics of the converter may be related to the self-consistent space charge potentials. Instabilities as possible sources of tube oscillations are briefly discussed. (auth)

12206 (AFCRL-299) COMPATIBLE ALKALINE EARTH OXIDE SYSTEMS FOR VACUUM THERMIONIC CONVERTERS. Scientific Report No. 8. M. D. Gibbons (General Electric Co. Research Lab., Schenectady). Mar. 1961. Contract AF19(604)-5472. 27p. (AD-260364)

The advantages and disadvantages of alkaline earth oxide systems are described for use as anode and cathode coatings in vacuum converters. The coating properties used to determine the choice include low anode work function, cathode stability such that a large emission current can be delivered, and the anode and cathode coatings which show compatibility with each other during life. These properties led to a choice of a system consisting of a strontium calcium oxide for the cathode and a barium strontium oxide for the anode. Emission measurements and evaporation rates for strontium calcium oxide on different base metals are presented. (auth)

12207 (AFCRL-430) RESEARCH ON THERMIONIC CONVERTERS. Final Report. (General Electric Co. Research Lab., Schenectady, N. Y.). June 1961. Contract AF-19(604)-5472. 145p. (AD-259880)

Thermionic conversion involves the generation of electricity from thermal energy utilizing the phenomenon of thermionic emission of electrons, and requires no moving parts. Types of converters which were the subjects of wide study include vacuum converters which have now been developed to the product design stage for cathode temperatures in the range of 1100 to 1150°C, anode temperatures 600 to 700°C and electrical power outputs of 0.2 watt/sq cm (min.) at an efficiency of 2.5%; vapor converters which have been developed for solar space power with an efficiency of 15% at a cathode temperature of 1800°C; and crossed-field converters which utilize a combination of electric and magnetic fields to direct the electron flow from cathode to anode in the converter. This particular line of development did not appear to be fruitful, and further work was not recommended on the crossed-field approach. (auth)

12208 (AFSWC-TDR-62-17) THE TRANSPORT OF NEUTRONS THROUGH THE ATMOSPHERE FOR A BURST HEIGHT OF 500,000 FEET. Alexander E. Anthony, Jr. and Eugene Omoda (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Feb. 1962. 39p.

A series of curves is presented showing the scattered and direct neutron flux per initial neutron from a burst height of 500 kfeet and sampling altitudes of 100, 200, 500, and 1,000 kfeet. The scattered flux data are calculated from a Monte Carlo Code. The direct flux data are calculated by the inverse square method. These data may be used to determine the fraction of the flux or dose attributable to the neutrons of various initial energies and selected energy bands; the total flux or dose from the scattered neutrons; the total flux or dose from the unscattered neutrons; and the total flux or dose arriving at a designated distance in space from a nuclear detonation at 500 kfeet. (auth)

12209 (AFSWC-TR-61-31(II)) STUDIES ON THE APPLICATION OF X-RAY AS A LETHAL MECHANISM OR DECOY DISCRIMINATION TECHNIQUE. VOLUME 2: STUDIES ON THE DYNAMIC RESPONSE OF SHELL STRUCTURES AND MATERIALS TO A PRESSURE PULSE. P. P. Radkowski, J. S. Humphreys, R. G. Payton, S. R. Bodner, and B. Budiansky (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.). July 1961. Contract AF 29(601)-2560. 194p. (AD-259757)

The application of x radiation as a lethal mechanism or decoy discrimination technique is studied theoretically. Studies of the dynamic response of shell structures and materials to a pressure pulse are described. Subjects such as dynamic buckling criterion of shallow shells under uniform impulsive loading, modal analysis of axisymmetric

buckling of clamped, shallow, spherical shells, dynamic membrane stresses in a circular elastic shell, dynamic collapse of a rigid-plastic ring under a distributed impulsive load, comparison of rigid-plastic-ring results with experiments, plastic collapse of ring with rigid outer layer, shock wave progagation in solid and compactible media, and large elastic deformations of dynamically loaded rings are examined. (auth)

12210 (ANL-6488) PHYSICS DIVISION SUMMARY REPORT. (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-Eng-38. 44p.

The use and operation of the 4.5-Mev Van de Graaff generator is described. Sputtering experiments were conducted by bombarding single crystals of electrolytic copper with deuterons with energies of 0.8 to 2.5 Mev. The experimental results are discussed on the basis of existing sputtering theories. The kinetic-energy distribution and Boltzmann "temperatures" of most of the fragments of cyanogen under electron impact were determined. A lower limit of 0.05 ev for this "temperature" was also determined for the mass spectrometer. A statistical theory of nuclear forces was developed in close analogy with the statistical mechanics of Gibbs. The theory of Byers and Yang was improved by removing the special assumption of cylindrical symmetry and the assumption of independent-particle motion. The safe assumption of time-reversal invariance was substituted for both. The quantum of trapped flux was found to be independent of the shape of the superconducting ring. The effective charge 2e was seen to result from the two-fold degeneracy induced by time-reversal invariance. It was observed that the same considerations which apply to the problem of flux quantization can be used to elucidate the gauge invariance of the theory of Bardeen, Cooper, and Schrieffer. Differences of total cross sections at high energies for meson-nucleon interactions are discussed under a hypothesis of generalized isospin independence. (auth)

12211 (CU(PNPL)-208) PROGRESS REPORT [IN NUCLEAR PHYSICS] FOR OCTOBER, NOVEMBER, DECEMBER 1960. (Columbia Univ., New York. Pegram Nuclear Physics Lab.). Contract AT(30-1)-GEN-72. 57p.

A summary is presented of measurements of mass distributions in thermal neutron fission of U^{235}; the magnetic moment of O^{15}; the effects of nuclear structure on the β decay of He^6 and Bi^{206}; and cross sections for (n-p) reactions, reactions $N^{15}(p,n)O^{15}$ and $N^{15}(p,\gamma)O^{16}$, reactions (d,n) on F^{19} and Ne^{20}, and slow neutron scattering by NH_3, NH_4F, NH_4Cl, NH_4Br, and NH_4I. Measurements on other reactions are discussed. Instrumentation development is described, with particular attention to an apparatus for measuring energy-dependent β-γ correlations, low-noise preamplifiers, a thyratron firing control system for a neutron velocity spectrometer, and a time-gated sequential multichannel 10-Mc scaler. (T.F.H.)

12212 (CU(PNPL)-213) PROGRESS REPORT [ON NUCLEAR RESEARCH] FOR JULY, AUGUST, SEPTEMBER 1961 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. (Columbia Univ., New York. Pegram Nuclear Physics Labs.). Contract AT(30-1)-GEN-72. 40p.

Results of an investigation of alpha-particle emission for thermal neutron fission of U^{235} show that total energy for ternary fission is equal to the mean total energy for binary fission. (p,γ) measurements were made on B^{11}, Al^{27}, K^{39}, Li^7, and V^{51} at proton energies of about 11 Mev. Typical spectra are shown. Experiments on energy-dependent beta-gamma angular correlation and beta-gamma circular polarization correlation are reported. Other experiments are reported on two-quanta emission from the 1.73-Mev O^+ level in Zr^{90}, and on a search for monoenergetic positrons in Bi^{206} decay. Instrument development is reported on charge-sensitive preamplifiers, transistorized positive-current-feedback double delay-line amplifiers, and low-noise transistorized positive-current-feedback charge-sensitive amplifiers. Development of a single-channel analyzer, a cyclotron firing control system and a coincidence-anticoincidence circuit is also reported. (J.R.D.)

12213 (DASA-1269) BLAST WAVE SOLUTIONS IN HYDRODYNAMICS. A Review. G. M. Schindler and A. Trampus (General Electric Co. Technical Military Planning Operation, Santa Barbara, Calif.). Dec. 31, 1961. Contract DA-49-146-XZ-038. 39p. (RM-61TMP-90)

A review and concise description are presented of existing approaches and computer codes for one- and two-dimensional hydrodynamic blast wave calculations. The assumptions and limitations are particularly discussed with regard to the possible application for determining the hydrodynamic effects resulting from a nuclear explosion in the atmosphere. Along with some suggested modifications, specific analytic-numerical methods from among those considered are recommended as most feasible. (auth)

12214 (EOS-2080-ML-2) FEASIBILITY STUDY TOWARD DEVELOPMENT OF RADIATION RESISTANT SOLAR CELL. Monthly Report, December 1, 1961 through December 30, 1961. S. Kaye (Electro-Optical Systems, Inc., Pasadena, Calif.). Jan. 15, 1962. Contract NAS7-92. 20p.

A number of radiation-resistant solar cells were fabricated using boron-diffused silicon. Efficiency, spectral response, and junction capacitance measurements were made on the cells. A more exact theory for the transit time across the base region of the cell was developed to determine the effects of a graded base structure on the operation of a solar cell. (D.L.C.)

12215 (JPL-TR-32-102) ELECTRON DISTRIBUTION FUNCTION OF A WEAKLY IONIZED GAS IN A MAGNETIC FIELD AND A TIME-DEPENDENT ELECTRIC FIELD. Jonas S. Zmuidzinas and Ching-Sheng Wu (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). June 15, 1961. Contract NASw-6. 27p. (AD-260567)

An investigation was made of electron behavior in a weakly ionized gas in a magnetic field and an arbitrarily time-dependent electric field. The electron distribution study is based on the Boltzmann equation which takes only the electron-atom collisions into account. A "moment method" was developed to solve the case in which the electron collision frequency is uniform. In the subsequent analysis, the electron distribution function was first expanded in terms of both the "moments" and the associated Laguerre polynomials. Then a generating equation of the moments was derived which is linear and of first order in time. The persistent solution was obtained in closed form for the quasisteady case. The drift velocity, the mean energy, the conductivity, and the dielectric constant are discussed for the case of a high-frequency oscillating electric field. (auth)

12216 (MIT-NSL-TR-364) MEASUREMENT OF FLUCTUATIONS IN RADIATION FROM A SOURCE OF THERMAL EQUILIBRIUM. Martin Harwit (Massachusetts Inst. of Tech., Cambridge. Naval Supersonic Lab. and Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). June 1960. Contract Nonr 1841(40). 109p.

The principal aim of this study is to measure the Bose-Einstein "classical" or "beat frequency" fluctuation in a

stream of photons from a source in thermodynamic equilibrium, and thus to verify the Einstein-Fowler equation of statistical thermodynamics: $\overline{(\Delta E)^2} = kT^2(\partial E/\partial T)$. By quantum statistical means, the fluctuation in the stream of radiation incident on a detector from a source at temperature, T, is determined. Further, the amount of cross correlation expected for the output current of two detectors illuminated by this source is derived. It is shown that the measured cross correlation depends on the source temperature and can be used as a measure of source temperature. The use of cross correlation to detect photon fluctuations has been termed "intensity interferometry" by Hanbury Brown and Twiss. Their theory of the intensity interferometer, based on electromagnetic formulation, is reproduced. Their results are then compared to the quantum statistical results in the region of common applicability. The two theories are found to concur. The results of the photon fluctuation experiments agree with the value predicted by the Einstein-Fowler equation, within the experimental error. Several applications of intensity interferometry are described. (auth)

12217 (NAA-AER-Memo-1173) THE VAPOR PRESSURES AND DENSITIES OF LIQUID FLUORINE–OXYGEN MIXTURES. Daniel D. Cubicciotti and H. Hori (North American Aviation, Inc., Downey, Calif.). Nov. 19, 1954. Contract [AT-11-1-GEN-8]. 12p.

Measurements were made of the vapor pressures and densities of liquid F_2-O_2 mixtures of 30, 50, and 70 wt % F_2 over the temperature range −196 to −185°C. The vapor pressures were from 1 to 3% above the ideal values and the densities were within 0.2% of ideal. The boiling point-composition diagrams for 760 and 750 mm were constructed. (auth)

12218 (NASA-TN-D-1191) MICROWAVE INTERFEROMETER MEASUREMENT OF ELECTRON-ION RECOMBINATION IN NITROGEN, AIR, AND ARGON. Perry W. Kuhns (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Feb. 1962. 36p.

Measurements of electron-density decay after an ionizing pulse were made, and electron-ion recombination coefficients were calculated from these values. Measurements were also made to show the effect of the introduction of water vapor on the recombination in air. Data are given on the change in electron density with pressure of an abnormal glow discharge. The theory of the propagation of an electromagnetic wave through a plasma is given along with the equations for using a microwave interferometer. Some of the practical considerations in using the microwave interferometer are presented. (auth)

12219 (NP-11304) QUARTERLY PROGRESS REPORT NO. 43 [ON SOLID-STATE PHYSICS]. (Massachusetts Inst. of Tech., Cambridge. Solid-State and Molecular Theory Group). Jan. 15, 1962. Contracts Nonr-1841(34) and AF19(604)-8445. 115p.

Progress is reported on studies of configuration interaction analyses of the electronic states of water molecules, evaluations of molecular integrals, electronic states of benzene, hydrogen molecule interactions, symmetry and free electron properties of the gallium energy bands, APW program for gallium structure, energy bands in nickel, band calculations for germanium and silicon, energy bands in nickel oxide by augmented plane wave methods, two-electron Heisenberg exchange interactions between neighboring atoms, perturbations in metals, bound states in spin-wave problems, and relations between the determinantal method and the method of fractional parentage coefficients. A review is presented of the activities of the Group during the past ten years since its inception, from 1951 through 1961. (B.O.G.)

12220 (NP-11342) DIREKTE UMWANDLUNG VON WARME IN ELEKTRIZITAT. EINE LITERATURUBERSICHT MIT ANNOTATIONEN. (Direct Conversion of Heat to Electricity. A Literature Search with Index). Oskar Liskowsky (Kernforschungsanlage, Julich, Germany). Nov. 1961. 88p.

An annotated bibliography is presented, consisting of 350 references to material on the direct conversion of heat to electricity. Author, corporate author, journal, patent, report number, and subject indexes are included. (T.F.H.)

12221 (NP-11346) PROBLEMS RELATED TO THE PROJECTION OF A SOFT, HIGH-CURRENT ELECTRON BEAM ALONG THE EARTH'S MAGNETIC LINES USING A ROCKET-BORNE ACCELERATOR. Special Report 1. Robert L. Schrag (Stanford Research Inst., Menlo Park, Calif.). Aug. 1961. Contract DA-49-146-XZ-067. 49p.

Calculations indicate that a 1-ampere, 10-kv electron beam could be magnetically confined over an indefinite length to a diameter of about 5 meters, ignoring any spreading due to scattering collisions. Assuming the beam to be produced in a vacuum, the effects of vehicle charging are severe. With the vehicle and the beam assumed to be located in the ionospheric region, the situation is improved. It is concluded that, even for the case of continuous emission, ionospheric conduction is sufficient to provide the 1-ampere return current required to keep the vehicle potential low. A further consequence of this conduction is an almost complete neutralization of space charge within the beam. (auth)

12222 (NP-11427) THE PHOTOELECTRIC K-ABSORPTION CROSS SECTION OF HELIUM AND LITHIUM. Technical Report No. 7. D. J. Baker, Jr. (Cornell Univ., Ithaca, N. Y.). Feb. 1962. Contract Nonr-401(37). 60p.

Measurements are made of the photoelectric absorption cross sections of He and Li near their K-edges, with uncertainties of about 4 and 10%, respectively. The measurements are compared with calculated values. (T.F.H.)

12223 (NP-11428) DUKE MICROWAVE LABORATORY FINAL REPORT ON [MICROWAVE RESEARCH], OCTOBER 12, 1959–JANUARY 31, 1962. Walter Gordy (Duke Univ., Durham, N. C. Microwave Lab.). Includes paper: DOUBLE QUANTUM TRANSITION IN ELECTRON SPIN RESONANCE OF GAMMA-IRRADIATED ACETYL-d, l-ALANINE. Mikio Katayama. Contract AF49(638)-765. 32p.

Work on microwave research is described. Double quantum transitions were observed at high r-f fields in hyperfine spectra of electron spin resonance of the free radical produced by gamma irradiation of acetyl-d, l-alanine. The presence of interaction between the free radicals gave rise to the double quantum transitions. A theoretical explanation is given. A bibliography of the 106 papers published by the Duke Microwave Laboratory 1953 to 1962 is included. (M.C.G.)

12224 (NP-11436) FIELD COILS FOR MHD GENERATORS. Research Report 119. Z. J. J. Stekly, T. A. deWinter, and A. El Bindari (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Nov. 1961. 30p.

The basic requirements for MHD generator coils are set forth, and performance of a typical MHD generator with room temperature, cryogenically cooled, or superconducting coils is analyzed. Various geometric configurations are considered for producing high magnetic fields parallel and

perpendicular to the axis of a cylindrical volume. These configurations are compared on the basis of maximum field per unit power expenditure, maximum field per unit mass of conductor, and uniformity of field in the region of interest. Comparison is made between water cooled, cryogenically cooled, and superconducting coils. Their respective areas of application are defined and the problems associated with each are discussed. (auth)

12225 (NYO-9808) ULTRAHIGH VACUUM TECHNIQUES. Quarterly Progress Report, October 1–December 31, 1961. Research Report 62-808-441-R1. (Westinghouse Electric Corp. Research Labs., Pittsburgh). Jan. 22, 1962. Contract AT(30-1)-2823. 17p.

Investigations were continued on the characteristics of zeolite traps and on a small cryopump. Studies of an all-metal vacuum system indicated that this system is superior to glass systems when operated at elevated temperatures. The major contribution to the gas evolution is hydrogen. The characteristics of an electron multiplier operating under ultrahigh vacuum procedures were studied. The desorption of gas by photons is being investigated. (M.C.G.)

12226 (ORNL-TM-13) AN ANALYSIS OF THE DISTURBANCE OF A URANIUM OXIDE CAPSULE SURFACE TEMPERATURE DISTRIBUTION RESULTING FROM A THERMOCOUPLE ATTACHED TO THE INSIDE SURFACE. P. H. Newell (Oak Ridge National Lab., Tenn.). Nov. 3, 1961. Contract [W-7405-eng-26]. 20p.

A study was initiated to determine the precision with which surface temperature measurements could be made in irradiation capsules containing ceramic fuel. A thermocouple was considered to be positioned in a longitudinal groove prepared in the uranium oxide and metallurgically bonded to the inside surface of the stainless steel clad. A fuel capsule having a $\frac{3}{4}$ inch outside diameter, designed as a segment of the EGCR fuel element, and operating with a heat generation rating of 27,500 Btu/hr/lineal foot was assumed. The finite difference approximation was employed to study both the grounded and the ungrounded types of thermocouple junctions. It was found that when a short dummy lead is positioned axially adjacent to the thermocouple junction deviations of about 118°F and 101°F are obtained for the grounded and ungrounded junction, respectively; in both cases the indicated temperatures are in excess of the undisturbed clad surface temperatures. (auth)

12227 (TID-14666) PRIMARY BEAM SCATTERING IN A MERCURY-VAPOR DISCHARGE. F. W. Crawford (Stanford Univ., Calif. W. W. Hansen Labs. of Physics). Dec. 1961. Contract AT(04-3)-326. 15p. (ML-872)

An analysis is presented concerning the scattering of the primary electron beam emerging from the space-charge sheath immediately in front of a plane, oxide-coated, cathode in a mercury-vapor discharge at a pressure of about 1μ. Probe characteristics were observed at a series of positions between anode and cathode, and were analyzed by the Druyvesteyn method to show the way in which the electron energy distribution function varies. The practical aspects of the technique and its applications are discussed. (auth)

12228 (TID-15010) DETERMINATION OF THE CRYSTAL STRUCTURES OF THE URANYL CUPFERRATES AND NEO-CUPFERRATES BY X-RAY DIFFRACTION METHODS. Third Annual Report. J. Lawrence Katz (Rensselaer Polytechnic Inst., Troy, N. Y.). Jan. 1962. Contract AT(30-1)-2325. 5p.

Research activities of the project were expanded to include a study of the neocupferrates. Work on rubidium and cesium uranyl cupferrates is continuing. A program for analyzing the cross-correlation of data between the various cubic uranyl cupferrates is in preparation for handling by the IBM 704 computer. Investigation of ammonium uranyl cupferrate is almost complete. An important aid in this work is a small optical analog Fourier computer, the Von Eller, which was used in conjunction with the IBM 650 and 704. Electron density calculations as recorded by the Von Eller are included. (J.R.D.)

12229 (TID-15059) EFFECT OF CORRELATION BETWEEN ENERGIES OF INCIDENT AND SCATTERED PARTICLES ON THE PERMEABILITY OF POROUS MEDIA. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Oct. 8, 1956. Contract [W-7405-Eng-26]. 6p. (KLI-3887)

The effect of the perfect correlation of energy between incident and scattered molecules on their low pressure transport through a bed of submicroscopically rough spheres is examined. The roughness is assumed to produce a cosine law distribution of angles in the scattered particles. It is found that the transport is identical with that which results in the case of scattering with completely uncorrelated energies and angles. (auth)

12230 (TID-15085) THE ZENER RELAXATION AS A DISTRIBUTION OF RELAXATION TIMES. A. S. Nowick and B. S. Berry (International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.). Aug. 10, 1961. Contract [AT(30-1)-2811]. 20p.

Most relaxation processes are not describable in terms of a single relaxation time, but require the introduction of a distribution of relaxation times. To obtain complete information about a relaxation process, it is important to know something about the functional form of the distribution and its width (the distribution parameter). This type of information is sought for the Zener relaxation in an Ag–30% Zn alloy. It is first shown that the form of the distribution function is difficult to determine, because the distribution is so narrow; however, a log normal distribution is assumed as most reasonable. Next, the distribution parameter is obtained as a function of 1/T by using creep data as well as internal friction at various frequencies. The results indicate that a major part of the distribution of relaxation times is due to a distribution of the activation energies. An effort is made to interpret the distribution of activation energies in terms of local concentration fluctuations in the solid solution. (auth)

12231 (TID-15135) STRUCTURE OF LIQUID METALS. [Progress Report], June 1961–February 1962. R. B. Gordon (Yale Univ., New Haven). Feb. 1962. Contract AT(30-1)-2029. 30p.

A calculation of the change in Hall coefficient in Cu_3Au with ordering is being made on the basis of nearly free electron theory. The occurrence of a positive Hall constant in the ordered alloy was explained on this basis. Magnetoresistance measurements on Cu_3Au were made as a function of domain size and degree of long range order. The results were compared with previous Hall effect experiments. Measurements of the Hall effect in liquid mercury are reported. (auth)

12232 (TID-15196) SPECIFIC HEAT OF He^3. Technical Report No. 1 [ON] RESEARCH ON THE PROPERTIES OF MATERIALS AT LOW TEMPERATURE. Gerhard Ludwig Salinger (Illinois. Univ., Urbana). Sept. 1961. Contract AT(11-1)-1056. 166p.

Results and discussion concerning an investigation are presented on the effects of pressure on the specific heat of He^3. Results are also compared with the results of theoretical work. (J.R.D.)

12233 (TID-15217) THE CRYSTAL STRUCTURE OF Sr_6Li_{23} AND Sr_3Li_2. Publication No. 2. Frederick E. Wang, Aden J. King, and Frank A. Kanda (Syracuse Univ., N. Y.). [1962?]. Contract [AT(30-1)-1910]. 23p.

Two intermediate phases Sr_6Li_{23} and Sr_3Li_2, of the Sr – Li phase equilibrium system were isolated in a single crystal form and their structures studied by single crystals x-ray methods. Methods are described for crystal growth and structure determinations. Drawings of the packing of the crystals are included. (C.H.)

12234 (USCEC-75-3) IONIZED SHOCK FRONT ANALYSIS. PART III. EFFECT OF JOULE HEATING ON ELECTRON DENSITY LEVEL AND MICROWAVE PROPERTIES DOWNSTREAM OF A STRONG SHOCK WAVE. Progress Report No. 3. Melvin Epstein (University of Southern California, Los Angeles. Engineering Center). May 31, 1961. Contract AF30(602)-2159. 29p. (RADC-TN-61-138; AD-262374)

An investigation was carried out of the interaction between a slightly ionized gas downstream of a shock wave and a microwave of sufficient strength to at least slightly alter the electron density level in the gas. The particular type of interaction was that resulting from the Joule heating of the gas. It was assumed that the gas is always in complete equilibrium and so the results may be considered to be valid only in the limiting case of collision frequency large compared to the signal frequency. The calculations indicated that this type of interaction may produce significant increases in electron density level for field strengths as low as one volt/cm under the appropriate conditions. (auth)

12235 (WADD-TR-60-22(Pt.III)) THERMOPILE GENERATOR FEASIBILITY STUDY. PART III. PERFORMANCE STUDIES. D. L. Kerr, ed. (General Electric Co., Schenectady, N. Y.). Aug. 1960. Contract AF 33(616)-5281. 418p. (AD-264926)

Descriptions are given of a large number of performance studies of thermoelectric generators for application as power sources in future air and space weapon systems. The studies were on fundamental relations for performance predictions, optimization, and heat sources. General aspects of thermoelectric generator design are included. (D.L.C.)

12236 (WADD-TR-60-370) THERMAL RADIATION PROPERTIES OF MATERIALS. R. A. Seban and R. E. Rolling (California. Univ., Berkeley. Inst. of Engineering Research). Oct. 3, 1960. Contract AF33(616)-6630. 110p.

Methods are described for the measurement, in air, of the total normal emittance at temperatures up to 2500°F; the normal spectral reflectance for wavelengths of 0.30 to 25 micron at low temperature; and the normal spectral reflectance for wavelengths of 1 to 25 micron at 1000°F. Results are given for 20 different materials. The measured total emittances are generally within 5% of the values predicted from reflectance measurements. Reflectances are also measured as function of angle for wavelengths on the order of 1 micron, in the range of interest for solar radiation studies. A spectral emittance unit is described, and preliminary results obtained using this unit are reported. (auth)

12237 (AEC-tr-4471(Add.)) OPTICS IN EQUIPMENT FOR THE UTILIZATION OF SOLAR ENERGY. LITERATURE CITED. V. B. Veinberg. Translation of p.225-33 from "Optika v Ustanovkakh Dlya Ispol'zovaniya Solnechnoi Energii" (a Publication of the State Publishing House of Defense Industry, Moscow, 1959). 15p.

About 325 references are included. (J.R.D.)

12238 (CEA-tr-R-1446) DECHARGE GAZEUSE AUX TRES HAUTES FREQUENCES. (Gaseous Discharge at Very High Frequencies). V. E. Golant. Translated into French from Uspekhi Fiz. Nauk, 65: 39-86(May 1958). 96p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 14073.

12239 (FTD-TT-61-281) THE EFFECT OF A TRANSVERSE MAGNETIC FIELD ON INTERNAL STRUCTURE AND HYDRAULIC RESISTANCE IN TURBULENT FLOWS OF LIQUID METALS. H. Branover and O. Lielausis. Translated from Latvijas PSR Zinātnu Akad. Vēstis, No. 1, 59-66(1961). 11p.

An experimental study is made of two opposing effects, namely: a drag by the field on the mean motion, accompanied by a visible change in the rate curve and an increase in the resistance; and the suppression of turbulent rate-pulsations, accompanied by a decrease in the resistance. Specifically, the magnetic field effects on rate distributions in smooth-walled and rough-walled channels and on the mass transfer in turbulent flow are determined. (T.F.H.)

12240 (NP-tr-840) ON THE EVALUATION OF CONDUCTIVITY GLOW CURVES. K. W. Boeer, S. Oberlaender, and J. Voigt. Translated by R. Hardbottle (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.). 45p. (Handwritten MS. Copy).

On the basis of a simple kinetic model containing electron traps of equal depths, the course of the solution functions of the system of equations corresponding to the model are discussed. Making certain approximations, a method is given for determining parameters of interest from conductivity glow curves, and an estimate is made of the errors involved in determining the parameters by this method. It is shown that the approximation formula of Randall and Wilkins is valid for conductivity glow curves, and even in cases where retrapping is not negligible it gives good values for the energy level of the traps with respect to the conduction band. (auth)

12241 (SCL-T-403) DESIGN OF PLASMA-JET GENERATORS AND THEIR SPECTROSCOPIC MEASUREMENTS. [PART] I. Tadao Horie, Tsutomu Ishimura, Yoshiaki Nakajima, Takayuki Nagura, Masamoto Otsuka, Masao Sawada, and Toshio Shiraiwa. Translated by Noburu Hiraga (Sandia Corp., Albuquerque, N. Mex.) from Oyo Butsuri, 29: 438-42(1960). 10p.

Design of plasma-jet generators is outlined for use in studies of high temperatures and for use in engineering studies were high-temperature techniques are required. Information is included on water-stabilized and gas-flow devices. (J.R.D.)

12242 THE MAGNETO-GRAVITATIONAL INSTABILITY OF A STRATIFIED MEDIUM. Andrzej G. Pacholczyk (Univ. of Warsaw). Atti accad. nazl. Lincei. Rend., Classe sci. fis., mat. e nat., 30: 738-43(May 1961). (In Italian)

The problem of magneto-gravitational instability in a stratified medium, a medium with variable density with respect to $z = x_3$, was studied. Since the solution of this problem in the general form is most complicated, the study was limited to the case of a non-rotating medium, considering the problem of instability in the rectagular coordinates x_1, x_2, x_3. It is assumed that the magnetic field, having only the component H_2, is proportional to the density of the medium and that the perturbation is propagated in the direction of x_1. The medium considered has infinite electric conductivity and zero coefficient of viscosity. (J.S.R.)

12243 THE GENERAL THEORY OF STEADY-STATE MOTION IN RELATIVISTIC HYDRODYNAMICS. I. S. Shikin (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 142: 296-8(Jan. 11, 1962). (In Russian)

The steady-state adiabatic behavior of an ideal gas in relativistic hydrodynamics can be related to the non-relativistic behavior of a gas. It is assumed that momentum, energy, and number of particles are conserved. It is shown that the velocity of sound in the relativistic gas is different from the velocity of sound in a non-relativistic gas. The Mach numbers are related as follows: $M^2(1 - M^2\omega^2/c^2) = M^2(1 - \omega^2/c^2)$, where M is the Mach number in the relativistic gas, M is the Mach number in the non-relativistic gas, c is the velocity of light and ω is the velocity of sound in the relativistic gas. Both gases obey the Clapeyron equation with the thermal variation per unit mass introducing a complication. The Bernouille flow in both systems is the same. Thus, the results of non-relativistic theory of steady-state flow can be carried over to relativistic gas dynamics. The conditions in a shock wave can be derived in an analogous fashion. (TTT)

12244 ENERGY MIGRATION IN SOLUTIONS AND ASSOCIATION THEORY OF LUMINESCENCE DAMPING. V. L. Levshin (Lebedev Inst. of Physics, Moscow and Moscow State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 43-52(Jan. 1962). (In Russian)

Energy transmission from an excited center to various centers in the medium and the relation between the structure of the center and its luminescence are analyzed. Concentrated internal luminescence damping and an external damping caused by outside particles are also studied. It is shown that the formation of non-luminescent associates causes physico-chemical transformations. Damping is reduced to two processes: inactive absorption and migration of energy from excited monomers to non-luminescent associates. (R.V.J.)

12245 HYDRODYNAMICS OF He^3–He^4 SOLUTIONS NEAR λ POINT. D. G. Sanikidze (Georgian Polytechnic Inst., SSR). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 4: 40-7(1961). (In Russian)

Hydrodynamic equations were derived for He^3–He^4 solutions in the immediate vicinity of the λ point. The propagation of sound near λ is analyzed. (tr-auth)

12246 SOME CONSIDERATIONS OF DYNAMIC BEHAVIOR IN THE PLASMA THERMOCOUPLE. R. W. Bussard (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys., 33: 606-13(Feb. 1962).

An analysis is presented of the role that stable electron oscillations of large amplitude may play in determining observed "steady-state" characteristics of a plasma-filled thermionic diode. The mechanism considered is that of coupling between electrostatic plasma oscillations, driven by the energy of the entrant electron "beam" from the emitter surface, and the potential distribution in the emitter sheath region. In operation such that net current flow is controlled by the sheath potential distribution, it is found that the time-averaged net current may increase markedly in transition from nonoscillatory to oscillatory operation, with a concurrent change in cell and load potential drops such that the diode acts as a negative resistance source of potential over a limited range. Conditions which restrict attainment of the oscillatory mode are discussed, and it is found that large amplitude electron waves may be generated and maintained over a wide and experimentally accessible range of plasma electron density. Comparison is made with experimental results, and an experiment is suggested for direct test of the driven-wave hypothesis. (auth)

12247 THERMODYNAMICS OF A SUPERCONDUCTING ENERGY CONVERTER. Marvin Chester (Electro-Optical Systems, Inc., Pasadena, Calif.). J. Appl. Phys., 33: 643-7(Feb. 1962).

A thermodynamic analysis is given for an energy conversion process that employs the phase transition in a superconductor. The conversion process is cyclic. An expression for the conversion efficiency is obtained. Quantitative estimates are calculated from the formula for superconducting materials. These indicate that conversion coefficiencies as high as 44% may be obtainable under ideal conditions. (auth)

12248 CHARGE TRANSFER SCATTERING IN HIGH-VELOCITY NEUTRAL PARTICLE PRODUCTION. Byron L. Johnson (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 33: 739-43(Feb. 1962).

The scattering of a beam of particles undergoing charge transfer collisions in a gas target was examined with emphasis on factors relevant to the design of a source of focused high-velocity (20 to 40-kev) neutral particles. Incident particles of helium, neon, and argon were used with targets of hydrogen, helium, neon, and argon gas over an energy range of 20 to 40 kev. An equation giving the number of neutral particles as a function of angular spread was developed and constants determined for its energy and gas target thickness dependence. Maximum percentages of neutrals available from a 20 to 40-kev helium ion beam incident on a helium gas target varies from 25% in a cone angle of 10^{-4} radians to 70% in a cone angle of 10^{-3} radians. (auth)

12249 FORCE-FREE COILS AND SUPERCONDUCTORS. Harold P. Furth (Univ. of California, Livermore) and Morton A. Levine. J. Appl. Phys., 33: 747-8(Feb. 1962). (UCRL-6498)

Configurations were designed using the electrolytic analog technique. In each case, there is a perfectly force-free coil structure surrounding a region of central field and itself surrounded by a pressure-bearing "diamagnetic" wall. A maximum field appears against this wall. In practice, the wall can be simulated by a second, nonforce-free winding, or, in the case of fast pulsed operation, by a solid conductor of suitable small skin depth. (L.N.N.)

12250 OPTICAL MASER CHARACTERISTICS OF Nd^{3+} IN CaF_2. Leo F. Johnson (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 33: 756(Feb. 1962).

Stimulated emission was observed at 77°K. Lamp intensity variation with time, including fluorescence and stimulated emission and scattered light at 1.046 γ at 77 and 95% above the threshold energy, was measured. Data are presented in graphical form. (L.N.N.)

12251 OPTICAL MASER CHARACTERISTICS OF Nd^{3+} IN $SrMoO_4$. L. F. Johnson and R. R. Soden (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 33: 757 (Feb. 1962).

Stimulated emission was observed at 77°K. Lamp intensity variation with time, including fluorescence and stimulated emission and scattered light at 1.0463 μ at 9 and 16% above the threshold energy, was measured. Data are presented in graphical form. (L.N.N.)

12252 INTENSITY INCREASE OF KIKUCHI LINES DURING ELECTRON BOMBARDMENT. Eiji Yoda (Cornell Univ., Ithaca, N. Y.). J. Appl. Phys., 33: 764-65(Feb. 1962).

Changes in intensity profiles of Kikuchi lines obtained in reflection electron diffraction from NaCl freshly-cleaved surfaces were measured as functions of exposure times

to electron beams. Data are presented in graphical form. Reduced data from microphotometer traces of photographic exposures were accurate within ±3%. The increase was about 5% after 3 min of electron bombardment at 3 $\mu amp/cm^2$. Afterwards, the intensity decreased rapidly. (L.N.N.)

12253 USE OF PROJECTION OPERATORS IN PERTURBATION THEORY. B. F. Gray (Royal Coll. of Advanced Tech., Salford, Lancs, Eng.). J. Chem. Phys., 36: 599-601(Feb. 1, 1962).

By the use of projection operators a series of approximations to the perturbed problem is generated, the first of which turns out to be the second-order Brillouin-Wigner theory. This connection is used to show that the latter is in certain cases either an upper or a lower bound to the correct energy. (auth)

12254 INTERACTION OF 0.2- TO 4.0-ev ELECTRON BEAMS WITH CLEAVED MgO. C. J. Cook and W. J. Fredericks (Stanford Research Inst., Menlo Park, Calif.). J. Chem. Phys., 36: 608-11(Feb. 1, 1962).

An attempt was made to determine the absorption coefficient δ_a for electrons incident on MgO and irradiated MgO for the impacting energy range, 0.2 ev through the conduction band (about 7.3 ev). It was found that electron trapping was so severe that the crystals would not thermally discharge at temperatures below 350°C. Consequently, the charged crystals were neutralized by a less satisfactory technique, high energy electron bombardment, δ_a was reproducible only at energies less than 4 ev. Sharp slope changes were observed at about 1.80 and 3.00 ev. These lines correspond to luminescence spectra obtained for catalytic recombination of N on MgO. Since slow electrons have been observed to interact predominantly with crystal defects, the data support the suggestion that defects can play a dominant role in catalytic reactions. (auth)

12255 DE-EXCITATION OF MOLECULAR VIBRATION BY COLLISION. Ernest Bauer and F. W. Cummings (Ford Motor Co., Newport Beach, Calif.). J. Chem. Phys., 36: 618-22(Feb. 1, 1962).

The reaction rate was calculated for a vibrationally excited diatomic molecule to be de-excited by collision with another atom or molecule, the second particle carrying away the excess vibrational energy as kinetic energy. The quantum mechanical distorted wave method was used in the modified wave number approximation, and the large amplitude of the vibrational motion is taken into account both in the choice of vibrational wave functions (Morse functions) and in the interaction potential. The calculation is performed for the process $N_2(a^1\Pi_g; v) + N_2(X^1\Sigma_g^+) \rightleftarrows N_2(a^1\Pi_g; v' < v) + N_2(X^1\Sigma_g^+)$ + kinetic energy for the vibrational transitions v = 5 to v' = 4, 3, 2, 1, 0, and for v = 2 to v' = 0 and v = 1 to v' = 0, for the temperature range 300 to 6000°K. The results show clearly that in a situation of this kind the collisional de-excitation of the molecular vibration proceeds in steps $v - v' = \delta v = 1$, rather than $\delta v > 1$. (auth)

12256 NEGATIVE ATOMIC IONS. [PART] II. J. W. Edie and F. Rohrlich (State Univ. of Iowa, Iowa City). J. Chem. Phys., 36: 623-7(Feb. 1, 1962).

Electron affinities of negative atomic ions were obtained in a previous paper [H. R. Johnson and F. Rohrlich, J. Chem. Phys. 30, 1608(1959)] by isoelectronic extrapolation using a four-term approximation formula. Recently, Edlén [B. Edlén, J. Chem. Phys. 33, 98(1960)] simplified this procedure, using only three terms and improved experimental input data. The theoretical justification of this procedure lies in the assumption that these formulas are the beginning terms of a perturbation series which is at least semiconvergent. Therefore, a four-term formula should give better results than a three-term formula. It is shown here that the experiments indicate that this is not likely to be the case, thereby raising strong doubts about the justification of this method. An alternative method is therefore suggested. Here, the regularity pattern of the ionization potentials as a function of Z (fixed degree of ionization) is extrapolated. This is therefore an extrapolation of the results of a horizontal analysis. The method requires one experimental affinity for each p shell as long as sufficiently precise data on ionization potentials of highly ionized atoms (fourth and higher spectrum) are not available. The results agree within experimental error, except for the most recent value of C^- which is about 10% too low. (auth)

12257 MOTION OF SMALL SUSPENDED PARTICLES IN NONUNIFORM GASES. Edward A. Mason (Univ. of Maryland, College Park) and Sydney Chapman. J. Chem. Phys., 36: 627-32(Feb. 1, 1962).

The motion of small suspended particles in a gas or gas mixture containing gradients of temperature, pressure, or composition is derived as a special case of the Chapman-Enskog kinetic theory of gases, by formally treating the suspended particles as large molecules. Gas molecules colliding with the suspended particles are considered to rebound elastically, but a fraction f rebound in random directions and the remainder rebound specularly. The results check, in an indirect way, previous calculations by a momentum transfer method on a slightly different model, in which the randomly rebounding molecules also have a random distribution of speeds. Significantly different results are predicted by the two models only in the presence of a temperature gradient (thermal diffusion), which has interesting implications concerning thermal diffusion in polyatomic gases. (auth)

12258 MANY-ELECTRON THEORY OF ATOMS AND MOLECULES. I. SHELLS, ELECTRON PAIRS VS MANY-ELECTRON CORRELATIONS. Oktay Sinanoğlu (Yale Univ., New Haven). J. Chem. Phys., 36: 706-17(Feb. 1, 1962).

A theory is developed (a) to see what the physically important features of correlation in atoms and molecules are; (b) based on this to obtain a quantitative scheme for N-electron systems as in He and H_2; (c) to see what happens to the chemical picture, to semiempirical theories, and to shell structure, when correlation is brought in. It is shown why, unlike in an electron gas, in many atoms and in molecules mainly pair correlations are significant. In configuration-interaction, multiple excitations arise not as three or more electron collisions, but as several binary collisions taking place separately but at the same time. The validity of theory is shown on Be, LiH, and boron. The theory does not depend on any perturbation or series expansion and the r_{12}-coordinate method can now be used for an N-electron system as in He and H_2. (auth)

12259 POTENTIAL CURVES FOR H_2^-. Ernest R. Davidson (Indiana Univ., Bloomington). J. Chem. Phys., 36: 1080-1(Feb. 15, 1962).

Discussion is given on the results obtained by Fischer-Hjalmars, Arkiv. Fys., 16: 33(1959), in which theoretical calculations were made on H_2^- in an attempt to explain experimental results obtained for the cross section of formation of H^- by electron impact on H_2. The potential curves found in the theoretical calculations were obtained by applying the variational method to the electronic Hamiltonian for H_2^-. It is felt that in this model of H_2^- the orbital ex-

ponent ζ' can be chosen ($\zeta' = 0$) so as to transfer the system into $H_2 + e$, which for some internuclear distances R has lower energy values than those calculated for H_2^-. The computational result concludes that with a limited variation (1s orbitals only and two independent ζ values) the minimum of the energy of H_2^- is equal to the energy of $H_2 + e$. (P.C.H.)

12260 POTENTIAL CURVES FOR H_2^-. Inga Fischer-Hjalmars (Royal Inst. of Tech., Stockholm). J. Chem. Phys., 36: 1081(Feb. 15, 1962).

It is stressed that the principal aim of previous calculations of potential curves of H_2^- was to look for possible states of H_2^- lying below the continuum of $H_2 + e$. Looking for possible low-energy states of H_2^-, having a nonzero value of ζ', the method of extrapolating the ζ values was used, being rather constant for large R values, to the range of small R and modified the wave function by inclusion of polarization terms. The result was that the ζ' values 0.5 and 0.15 give $E(H_2^-) - E(H_2 + e)$ not larger than 1.7 and 0.3 ev, respectively. The results show three things: potential curves should be considerably revised for short internuclear distances; $E(H_2^-)$ is a very slowly varying function of ζ'; and investigations with improved models may give the small corrections, necessary to render $E(H_2^-) < E(H_2 + e)$, corresponding to a stable doublet of H_2^-. (P.C.H.)

12261 BINDING ENERGY OF Ar_2^+ FROM ION SCATTERING DATA. Robert D. Cloney, Edward A. Mason, and Joseph T. Vanderslice (Univ. of Maryland, College Park). J. Chem. Phys., 36: 1103-4(Feb. 15, 1962).

A determination of the binding energy of Ar_2^+ based on the elastic and inelastic scattering measurements of Ar^+ in Ar is reported. Both Φ_u and Φ_g were approximated by the average potential $\Phi_{u,g} = Ae^{-br}$. The measured elastic scattering cross sections were used to determine the parameters with the results $A = 5.38 \times 10^6$ ev and $b = 5.08$ A^{-1}. $Q^{1/2}$, which depends on the difference $\Phi_u - \Phi_g$, was then plotted against low W, where W is the ion beam energy. A value of α was then picked so that the average of Φ_u and Φ_g was approximately $\Phi_{u,g}$ at r = 3.4 A. Consistent results were obtained for $\alpha = 8$, $D_e = 0.0035$ ev, and $r_e = 4.5$ A. Potential curves, valid from 3.54 to 5.06 A, were obtained. An analysis of the data indicates that the three-electron bond energy approximation does not hold for Ar_2^+. (P.C.H.)

12262 THERMOLUMINESCENCE OF THORIA. E. H. Greener (Marquette Univ., Milwaukee), W. M. Hirthe, and E. Angino. J. Chem. Phys., 36: 1105-6(Feb. 15, 1962).

A large symmetrical glow peak was found in unirradiated thoria at 195 ± 5°C. Upon irradiation with Co^{60}, a second smaller peak appeared at 65 ± 5°C. After thoria was subjected to about 10^4 r, both peaks began to grow. The time to decay to one-half intensity was measured at 100, 125, and 150°C for the 195°C peak in unirradiated thoria. The activation energies based on calculations for seven curves are 1.22 ± 0.05 and 0.65 ± 0.10 ev for the 195 and 65°C peaks, respectively. Assuming a first-order process, the 195°C peak is definitely established as the result of a first-order reaction. Indications that the 65°C peak may be the result of a second-order decay are given. (P.C.H.)

12263 STOCHASTIC METHODS IN QUANTUM MECHANICS. Alladi Ramakrishnan and N. R. Ranganathan (Madras Univ.). J. Math. Anal. and Appls., 3: 261-94 (Oct. 1961).

Relations to quantum mechanics of the superposition principle, the concepts of realization and inverse probability, product densities of many-particle systems, the method of regeneration points, and ambigenous stochastic processes are discussed. An alternative interpretation of the Feynman formalism and direct proof of equivalence of the Feynman and field-theoretic formalisms are presented. Possibilities of developing a nonperturbative approach using Feynman formalism by adopting study methods for ambigenous processes evolving both forward and backward, with respect to a one-dimensional, parameter are discussed. Results in the theory of linear matrix equation solutions are presented. (L.N.N.)

12264 ACTION PRINCIPLE FOR CLASSICAL MECHANICS. L. M. Garrido (Universidad, Zaragoza, Spain). J. Math. Anal. and Appls., 3: 295-314(Oct. 1961).

A differential action principle, $\delta p = -\partial\delta W/\partial p$; $\partial p = \partial\delta W/\partial q$, is obtained using variations of the action integral. It yields Hamilton's equations of motion, provides a general method to treat perturbations in classical mechanics, and corresponds to Schwinger's principle of quantum mechanics. (auth)

12265 ANALYSIS OF GAMMA-RAY SCINTILLATION SPECTRA BY THE METHOD OF LEAST SQUARES. L. Salmon (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 14: 193-9 (Dec. 1961). (AERE-R-3640). (In English)

The least-squares method is applied to the analysis of gamma scintillation spectra, the calculations being performed on a computer. Analytical results are obtained rapidly, the accuracy being consistent with the calculated precision. The method is particularly suited to routine analysis at low counting rates. (auth)

12266 TWO-DIMENSIONAL ANALYSIS OF NEUTRON TIME-OF-FLIGHT AT SEVERAL KEV AND THE ENERGY OF γ-EMISSION IN COINCIDENCE. R. Ballini, Y. Cassagnou, and J. M. F. Jeronymo (Centre d'Etudes Nucléaires, Saclay, France). Nuclear Instr. & Methods, 14: 222-4(Dec. 1961). (In French)

The simultaneous recording of two phenomena in a magnetic tape makes possible the study of the gamma-rays emitted by an excited nucleus produced by neutron emission near threshold; a very good separation by time-of-flight of the neutrons corresponding to different neighboring excited states; and the measurement of the variation of the cross section in a small energy interval. (auth)

12267 THE RESONANCE INTEGRAL FOR URANIUM METAL AND OXIDE. E. Hellstrand and G. Lundgren (Aktiebolaget Atomenergi, Stockholm). Nuclear Sci. and Eng., 12: 435-6(Mar. 1962).

The resonance integrals for U metal and U oxide are measured in a Cd container in a natural U–heavy water lattice, with a standard deviation of ± 5%. (T.F.H.)

12268 REMARKS ON A POSSIBLE METHOD FOR DETECTING THE DOUBLE COMPTON EFFECT. M. Carrassi and G. Passatore (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo cimento (10), 22: 1316-20(Dec. 16, 1962). (In English)

Observations of the double Compton effect are made without using coincidence measurements. The cross section integrated over the direction of one of the two photons is studied; the other direction is held constant and is observed. It is seen as a tail to the single Compton line on the low-energy side. A factor of about ten is gained in the cross section. (L.N.N.)

12269 ON THE FEASIBILITY OF PHONON DIFFRACTION IN LIQUID HELIUM. E. T. Kornhauser (Bristol Univ., Eng.). Phys. and Chem. Solids, 21: 228-33(Dec. 1961). (In English)

The feasibility of diffracting the phonon radiation from a heat source in a liquid helium bath at about 0.3°K was

examined, and a proposed experiment is described in some detail. The performance of ordinary optical diffraction gratings at the very short wavelengths involved was analyzed and found to be adequate for the purpose. (auth)

12270 PHOTOCAPACITANCE EFFECTS IN ADDITIVELY COLORED ALKALI HALIDE CRYSTALS. J. Ross MacDonald (Texas Instruments, Inc., Dallas). Phys. and Chem. Solids, 21: 313-5(Dec. 1961). (In English)

Measurements were made previously, MacDonald, J. Chem. Phys. Solids, 17: 210(1955), of the capacitance and conductance of a photoconducting crystal containing F-centers as a function of light intensity, frequency, d-c bias, and a-c signal amplitude. F-centers were produced by gamma irradiation of U-centered crystals. Discussion is given on the low frequency limiting capitance interpreted by others, Kahn and Glass, J. Phys. Chem. Solids, 17: 210 (1961) as arising from electrode space charge associated with conduction-band electrons released from F-centers by light absorption. This conclusion was found to be untenable for the results obtained by MacDonald. It is concluded that the formula for low-voltage space-charge capacitance is not applicable to Kahn and Glass's results, and the approximate agreement of the electron mobilities with directly measured values must be a coincidence. The applicability of the linearized a-c space-charge theory was not demonstrated, and the data are rejected as being in agreement with this theory. (P.C.H.)

12271 THE STRUCTURE OF SHOCK WAVES. G. Ya. Lyubarskii. Priklad. Mat. i Mekhan., 25: 1041-9(Nov.-Dec. 1961). (In Russian)

The problem of shock waves is examined from the point of view of magnetohydrodynamics in the approximation that the viscosity and thermal conductivity are small, and electrical conductivity very large. Dissipative equations are developed as in magnetohydrodynamics, and shock waves are described as corresponding uniquely to conditions of stability against breakup. The profiles of the shock waves are examined, and continuous profiles as well as profiles with transitions are described. (TTT)

12272 THE DE HAAS-VAN ALPHEN EFFECT AND THE ELECTRONIC STRUCTURE OF METALS. D. Shoenberg (Royal Society Mound Lab., Cambridge, Eng.). Proc. Phys. Soc. (London), 79: 1-9(Jan. 1, 1962).

Fermi surface determination methods for polyvalent, transition, and monovalent metals are presented. Fermi surfaces surfaces were broken up into sheets by intersections with Brillouin zone boundaries. High voltages were applied in an impulsive field method. The free-electron model for the aluminum Fermi surface is discussed. A schematic model of a noble-metal Fermi surface is presented. The anomalous skin effect resistance of copper is discussed. Data are presented in graphical form. (L.N.N.)

12273 CHARACTERISTIC ELECTRON ENERGY LOSS SPECTRA OF SOME ALKALI METALS AND ALKALINE EARTHS. J. L. Robins and P. E. Best (Univ. of Western Australia, Nedlands). Proc. Phys. Soc. (London), 79: 110-18(Jan. 1, 1962).

The characteristic electron energy loss spectra of Na, K, Ca, and Ba were obtained using the reflection technique and primary electron energies of 800 and 1500 ev. All energy losses observed in these metals can be explained as arising from excitation of plasma-type oscillations, electronic transitions involving excited states, and ionization. Plasma excitation energies of 5.87 and 3.87 ev were observed in Na and K, respectively. The first plasma loss peak in the spectra of these metals was displaced from its expected position. Loss peaks in K, Ca, and Ba that are considered to be associated with excited states were related to a series of peaks in Ti, V, and Cr, and a peak in Zr. The specific form of the excited state involved cannot be determined from this data alone, but evidence is presented suggesting that an intense broad peak of this nature will occur in the spectra of all the elements immediately preceding or at the beginning of each series of transition metals. (auth)

12274 CHARACTERISTIC ELECTRON ENERGY LOSS SPECTRA OF A NUMBER OF SOLID ELEMENTS. J. L. Robins (Univ. of Western Australia, Nedlands). Proc. Phys. Soc. (London), 79: 119-32(Jan. 1, 1962).

Characteristic electron energy loss spectra of Ga, In, Tl, As, Se, and Te were obtained using the reflection technique and primary electron energies of 1500 and 800 ev. Results are discussed in conjunction with those for Ge, Sn, Pb, Sb, and Bi. The spectra of these elements comprise principally plasma and lowered plasma losses and combinations and multiples of these, together with losses associated with ionization and in Se and Te, a loss presumably due to an interband transition. The plasma loss peak is narrower where there is agreement between these values is discussed. A résumé is given of the results obtained for 33 elements using the same unit of equipment. In elements other than the transition and noble metals, the excitation of plasma type oscillations is the dominant loss mechanism, almost to the exclusion of interband transitions, while the latter are of much greater importance in the complex spectra of the transition and noble metals. Ionization is observed in the majority of the elements studied. (auth)

12275 THE CHARACTERISTIC ELECTRON ENERGY LOSS SPECTRA OF SOME ALKALI HALIDES. P. E. Best (Univ. of Western Australia, Nedlands). Proc. Phys. Soc. (London), 79: 133-47(Jan. 1, 1962).

Characteristic electron energy loss spectra of LiF, LiCl, NaF, NaCl, NaBr, NaI, KF, KCl, KBr, KI, RbCl, CsBr, and CsI, were measured using primary energies of 800 and 1500 ev. In each spectrum, a peak due to the excitation of the valence electron plasma oscillation is observed. There is good agreement between this energy loss and the plasma energy $\hbar\omega_p$, calculated assuming that the valence electrons are able to participate in such oscillations. In some spectra, a loss peak at energy approximately $\hbar\omega_p/\sqrt{2}$ is observed, due to the excitation of a longitudinal plasma oscillation, although these are not identified with present theory. Of the other peaks observed, some are thought to be due to ionization of atoms and ions in different levels; the occurrence of a peak for cations heavier than sodium is discussed in terms of an excited state, further peaks are attributed to interband transitions, and others go unidentified. The K x-ray absorption curves for the potassium ion in the potassium halides are reproduced to show that in intensity and energy, the x-ray absorption can be represented as due to the excitation of a K electron to the valence band with simultaneous excitation of some mode of plasma oscillation. (auth)

12276 SECONDARY ELECTRON EMISSION FROM CLEAN METAL SURFACES BOMBARDED BY FAST HYDROGEN IONS. L. N. Large and W. S. Whitlock (Services Electronics Research Lab., Baldock, Herts, Eng.). Proc. Phys. Soc. (London), 79: 148-57(Jan. 1, 1962).

The secondary electron emission coefficient γ was measured for clean Au, Pt, Ag, Mo, Cu, Ni, Zr, Ti, and C surfaces bombarded with H_1^+, H_2^+, and H_3^+ ions 10 to 140 kev.

Measurements of γ were made within the monolayer adsorption time (~5 min) after flashing the targets to a high temperature in background pressures of approximately 10^{-8} mm Hg. The measured values of γ intrinsic to clean metal surfaces are relatively low, e.g. $\gamma = 1.5$ for 100-kev protons incident on atomically clean molybdenum. A maximum in the yield curve for protons is found to occur 3×10^8 to 4×10^8 cm sec^{-1}. The yield for H_2^+ ions is almost twice that for protons at the same velocity and the yield for H_3^+ ions is only about 17% less than that for three protons at the same velocity. For a given ion, γ is found to vary little for the metals studied although the coefficient does increase slowly with atomic number. Measurements involving D_1^+ and He^+ ions show that the yield for D_1^+ is exactly the same as that for protons at the same velocity. The yield for He^+ is approximately twice that for protons. Results are discussed in relation to a theory of secondary electron emission. Partial agreement is observed. (auth)

12277 THE RYDBERG-KLEIN-REES METHOD OF CONSTRUCTING THE TRUE POTENTIAL ENERGY CURVES OF DIATOMIC MOLECULES. N. L. Singh and D. C. Jain (Banaras Hindu Univ., Varanasi, India). Proc. Phys. Soc. (London), 79: 274-8(Feb. 1, 1962).

Alternative simplified expressions were deduced for f and g involved in the calculation of the true potential energy curves of such electronic states of diatomic molecules whose vibrational terms cannot be adequately represented by a quadratic in $v + \frac{1}{2}$. These expressions were used in calculating the true potential curve of the $B^3\Pi_{0u}^+$ state of the $Br^{79}Br^{81}$ molecule and the results show a close agreement with those obtained by Rees. The true potential energy curve of the $A^1\Sigma^+$ state of LiH molecule has also been calculated, and results agree with those obtained previously. (auth)

12278 ON THE APPLICATION OF TWO SIMPLE APPROACHES OF 'ATOMS IN MOLECULES.' Alicia Batana and Norah V. Cahan (Universidad, Buenos Aires). Proc. Phys. Soc. (London), 79: 279-83(Feb. 1, 1962).

Approaches of the method of 'atoms in molecules' were applied to the lowest $^1\Sigma_u^+$ state of the hydrogen molecule. A trial wave function made up from a linear combination of a covalent ($1s\ 2p\sigma$) and an ionic structure ($1s^2$) was used. The effect of different procedures used for selecting orbital exponents and mixing coefficients of covalent and ionic functions was studied, and the risk of using a minimization procedure was considered. (auth)

12279 VARIATION OF TOWNSEND'S SECOND COEFFICIENT IN A ELECTRODELESS DISCHARGE IN CROSSED ELECTRIC AND MAGNETIC FIELDS. S. N. Sen and A. K. Ghosh (Jadavpur Univ., Calcutta). Proc. Phys. Soc. (London), 79: 293-8(Feb. 1, 1962).

From measurement of breakdown potentials in an electrodeless discharge in a magnetic field, values of γ_H, Townsend's second coefficient in a magnetic field, were calculated. The curve between γ_H and H is hyperbolic in nature. For 10, 25, and 57.5 μ pressure, the magnetic field varied from 0 to 60 gauss. Assuming $\gamma = A' (E/p) + [B'/(E/p)] + C'$, which is valid if E can be regarded as constant, an expression was deduced for the variation of γ_H with magnetic field in an electrodeless discharge. The formula can explain the observed variation of γ_H with magnetic field, and the quantitative agreements is also satisfactory. It is suggested that the incorporation of the variation of γ with magnetic field with the concept of equivalent pressure will explain the experimental results better. (auth)

12280 ION SORPTION IN THE PRESENCE OF SPUTTERING. G. Carter, J. S. Colligon, and J. H. Leck (Univ. of Liverpool). Proc. Phys. Soc. (London), 79: 299-309 (Feb. 1, 1962).

A model to describe gas sorption during ion bombardment of solid surfaces was developed in analytical terms, assuming any general form for the ion penetration probability. It is shown how continuous measurement of the gas sorbed, up to saturation conditions, can lead to a deduction of the form of the penetration function, and how investigation of the depth distribution at saturation can also lead to the form of this function. It is emphasized that in order to obtain the exact form of the penetration function from the depth distribution, either saturation conditions must be attained or very small quantities of gas must be sorbed. The theory is also extended to include the case in which a surface is continuously replenished rather than eroded by sputtering. Penetration probability curves are deduced from experimental studies. They are of the form anticipated from the Bohr theory of penetration. Possible modifications to the theory are outlined. (auth)

12281 THE PRESSURE DEPENDENCE OF THE SECOND IONIZATION COEFFICIENT IN HYDROGEN AT LOW PRESSURES. J. G. C. Milne (Univ. of Sheffield, Eng.). Proc. Phys. Soc. (London), 79: 314-16(Feb. 1, 1962).

Experiments on sparking potentials in hydrogen at 10 to 100 mm Hg show that the sparking potential is not just a function of the product of gas pressure and sparking distance (Paschen's law), but decreases as the gas pressure is decreased. Deduced values of the generalized secondary coefficient show an approximately linear pressure dependence. The loss of excited molecules by collisions of the second kind proposed by Davies, Dutton and Llewellyn Jones (Proc. Roy. Soc., 72: 1061(1958)) seems inadequate to account quantitatively for these results. The loss of excited molecules by collision with the anode is suggested as an additional mechanism. (auth)

12282 THE SCINTILLATION PROPERTIES OF CADMIUM FLUORIDE. R. V. Jones and J. H. Pollard (Univ. of Aberdeen, Scotland). Proc. Phys. Soc. (London), 79: 358-65(Feb. 1, 1962).

Pure crystals of CdF_2 scintillate with 7.1 nanosec decay time and an efficiency low but sufficient for the purpose of high energy spectroscopy. The decay time and the efficiency are temperature dependent; at $-178°C$ the former increases to 120 nanosec and the latter to 14 times its room temperature value. The crystals are optically clear from 2200 Å; the scintillation emission band extends from 5000 to 5800 Å. Large crystals were used to detect cosmic μ mesons and the resolution obtained is in reasonable agreement with the expected value. The short radiation length (1.6 cm) of CdF_2, combined with the fact that large (e.g. 14-cm diameter) crystals can be grown, offers possibilities for high-energy gamma spectroscopy, and the fast decay time may allow the investigation of fundamental-particle reactions. (auth)

12283 THE SCINTILLATION PHENOMENON IN ANTHRACENE. I. RADIATION DAMAGE. H. B. Clarke, D. C. Northrop, and O. Simpson (Services Electronics Research Lab., Baldock, Herts, Eng.). Proc. Phys. Soc. (London), 79: 366-72(Feb. 1, 1962).

Effects of radiation damage on the scintillation efficiency of anthracene crystals are shown to be comparatively small. They cannot account for low efficiencies observed for particles of high specific ionization, even where the integrated effects of prolonged irradiation are very marked. Evidence is found for a reduction in scintillation efficiency

in impure anthracene, where emission occurs only from impurity centers, but this is a co-operative effect between excited states and is not connected with permanent radiation damage. (auth)

12284 THE SCINTILLATION PHENOMENON IN ANTHRACENE: II. SCINTILLATION PULSE SHAPE. P. E. Gibbons, D. C. Northrop, and O. Simpson (Services Electronics Research Lab., Baldock, Herts, Eng.). Proc. Phys. Soc. (London), 79: 373-82(Feb. 1, 1962).

Examination of the scintillation pulse shape in anthracene indicates that the slow components (~1 μsec decay time) are due to short range interactions between pairs of excitons. These components are observed in the fluorescence decay due to pulsed ultra-violet excitation when the intensity is increased to produce an exciton density approaching that near the track of an ionizing particle. Deductions concerning the scintillation pulse shape in impure anthracene are supported by experiment. (auth)

12285 ON THE PLASMA OSCILLATIONS IN METAL FOILS. Hideo Kanazawa (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 26: 851-60(Dec. 1961). (In English)

The dispersion relations, lifetimes of plasmons in metal foils, and the probability of plasmon excitation by incident electrons are derived quantum mechanically. The results obtained are the generalizations of Ferrell's semi-classical theory. (auth)

12286 FLUORESCENCE DECAY TIME OF SOME AROMATIC HYDROCARBONS IN α-PARTICLE EXCITATION. A. Schmillen and K. Kramer (Universität, Giessen, Ger.). Z. Naturforsch., 16a: 1192-9(Nov. 1961). (In German)

Estimations on the decay time (partially also on the rise time) were obtained from the Fourier spectrum of scintillation light flashes in α irradiated crystalline powders of aromatic hydrocarbons. The pure crystal powders all show a complicated exponential decay time of the luminescent flashes. On the other hand an almost simple exponential decay was found for the luminescence of the strange molecules built into the same host lattice. The measured values for the decay times are tabulated. Consequences, which result from the excitation mechanism, are discussed. (tr-auth)

12287 THE PROBLEM OF IRREVERSIBILITY WITHIN THE FRAMEWORK OF A GENERALIZED ENTROPY CONCEPT. Folker Engelmann, Marc Feix, Ettore Minardi, and Joachim Oxenius (EURATOM-CEA, Fontenay-aux-Roses, France). Z. Naturforsch., 16a: 1223-32(Nov. 1961). (In German)

In view of the fact that physical measurements represent transmission of information, a general definition based on the measure of "lack of knowledge" in information theory can be introduced for different entropies each of them corresponding to one particular kind of measurement. By means of this entropy concept the problem of the consistency of microscopic reversibility and macroscopic irreversibility is studied. Under certain conditions it can be shown that the reversible microscopic equation of motion leads to the result that all entropies corresponding to "reduced" quantities, i.e., to quantities which do not determine the microscopic state of the system completely, can never decrease. However, it is to be noted that this behavior is symmetric in time, in the classical as well as in the quantum mechanical case. Irreversibility is so related on the one hand to incomplete description of a system, but on the other also to the fact that theoretical statements can be verified by experiments in the future only. The validity of the results obtained within the framework of ensemble theory for a single physical system is discussed. As applications of the general ideas a system of free particles and the Boltzmann gas are treated. (auth)

12288 THE GAS IONIZING RADIATION OF A DISCHARGE IN N_2-O_2 MIXTURES (QUANTITATIVE DETECTION OF SMALL O_2 CONCENTRATIONS IN N_2). A. Przybylski (Universität, Hamburg). Z. Naturforsch., 16a: 1232-7(Nov. 1961). (In German)

A method is given for tracing quantitatively small quantities of oxygen (down to 10^{-5} parts in 1) in mixtures of oxygen and nitrogen. The method is based on the effect of the ionization of oxygen molecules in a mixture of oxygen and nitrogen by radiation emitted by nitrogen molecules with ionization potentials $U_{O_2} < U_{N_2}$ and the energy of radiation between U_{O_2} and U_{N_2}. Coefficients of absorption and intensities of this ionizing radiation are given in dependence on the concentration of oxygen. A radiation emitted by nitrogen and ionizing nitrogen itself is traced and its coefficient of absorption ($\mu \approx 750\ cm^{-1}$) and its intensity are measured. (auth)

12289 BEAMS FROM CONDENSED HALIUM IN HIGH VACUUM. E. W. Becker, R. Klingelhoefer, and P. Lohse (Kernforschungszentrum, Karlsruhe, Ger. and Technische Hochschule, [Karlsruhe, Ger.]). Z. Naturforsch., 16a: 1259(Nov. 1961). (In German)

In an earlier work (Z. Phys., 146: 333(1956)) it was shown how condensed molecular beams of hydrogen could be produced by cooling a nozzle with liquid hydrogen. In the present article, the production of condensed helium beams by improving the cryostat and pumping apparatus is described. (J.S.R.)

12290 THE ANISOTROPY OF THE SCINTILLATION LIGHT YIELD OF ORGANIC MOLECULAR SINGLE CRYSTALS FOR α PARTICLES. W. F. Kienzle and A. Flammersfeld (Universität, Göttinger, Ger.). Z. Physik, 165: 1-11(1961). (In German)

Single crystals of anthracene and trans-stibene when irradiated by α particles show a strong dependence of their scintillation light yield on the impact direction of the α particles with respect to the crystal orientation. This having been established in earlier papers, further investigations of 11 other compounds confirm this effect which now seems to be a common feature of monocrystalline organic scintillators. For explanation a possible relation between the anisotropy of the scintillation light yield and that of the electronic conductivity is proposed. (auth)

12291 THE SCINTILLATION ANISOTROPY OF ANTHRACENE AT LOW TEMPERATURES. P. H. Heckmann, W. Sander, and A. Flammersfeld (Universität, Göttingen, Ger.). Z. Physik, 165: 12-16(1961). (In German)

An anthracene crystal was cooled down to liquid hydrogen temperature and was bombarded with alpha particles in two directions parallel to the b and c' crystal axes. The ratio of maximum to minimum light yield (for alpha particles parallel to c' and b, respectively) is reduced to 1.23 at 20.4°K. This ratio is 1.46 for ThC' and 1.53 for ThC alpha particles at room temperature and is measured as a function of temperature between 20.4 and about 90°K. (auth)

12292 ELECTRON TERMS OF TRIVALENT PROMETHIUM. S. Huefner (Technische Hochshule, Darmstadt, Ger.). Z. Physik, 165: 397-401(1961). (In German)

The terms of Pm^{3+} ions for the case of average coupling were calculated and compared with the absorption spectrum obtained in a solution of $PmCl_3$ in D_2O. (tr-auth)

12293 MEASUREMENT OF THE HYPERFINE STRUCTURE SPLITTING OF THE METASTABLE $^3P_2$ STATE OF Kr^{83} BY THE ATOMIC BEAM RESONANCE METHOD. Hajo Kuiper (Universität, Heidelberg). Z. Physik, 165: 402-18(1961). (In German)

The hyperfine structure splitting of the metastable $^3P_2$ state of Kr^{83} was measured by the atomic beam magnetic resonance method. A glow discharge served as a source of metastable atoms which were detected by surface ejection of electrons from a metal. In order to improve the signal-to-noise ratio the magnetic C-field was modulated at a frequency of 37 cps. From the measured splittings the following hfs coupling constants were determined: $A(^3P_2) = -(243.970 \pm 0.004)$ Mc/sec and $B(^3P_2) = -(452.12 \pm 0.08)$ Mc/sec. The nuclear electric quadrupole moment was calculated from the B-factor: $Q = +(0.251 \pm 0.005) \times 10^{-24}$ cm^2. (auth)

12294 THE EFFECT OF ANHARMONICITY ON THE THERMAL X-RAY SCATTERING ON CRYSTALS. Harro Hahn (Kernforschungsanlage, Jülich, Ger.). Z. Physik, 165: 569-600(1961). (In German)

Work already published by W. Ludwig and the author was limited to crystal temperatures above the Debye temperature, as it treated the lattice vibrations by classical statistics. In this paper, a complete quantum-statistical treatment is presented. The essential features of the high-temperature results remain unchanged. New, temperature dependent dispersion curves may be introduced which, for long waves, are determined by the isothermal elastic constants. (auth)

12295 SLOWING DOWN OF MULTI-CHARGED IONS IN SOLID AND GASEOUS MEDIA. Ya. A. Teplova, V. S. Nikolaev, I. S. Dmitriev, and L. N. Fateeva (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 44-60(Jan. 1962). (In Russian)

The ranges and specific energy losses of fast He, Li, Be, B, C, N, O, Ne, Na, Mg, Al, P, Cl, K, Br, and Kr ions possessing velocities between 2.6×10^8 and 11.8×10^8 cm/sec were measured in hydrogen, helium, methane, benzene, air, argon, and their mixtures. Specific energy losses in celluloid, Al, Ni, Ag, and Au were also measured. The dependence of the ion ranges and specific energy losses on the nuclear charge Z, is not monotonous due to peculiarities in the electron structure. The effective ion charge is 10 to 20% larger than the mean charge in the equilibrium distribution. With increased Z the stopping power of solid substances decreases at a much higher rate than in gaseous substances. However, the difference between the mean energy losses in gases and solids is small. Energy losses in charge exchange do not exceed 25% of the total energy losses. (auth)

12296 INVESTIGATION OF THE ANGULAR DISTRIBUTION OF PHOTOELECTRONS EJECTED BY Cs^{137} γ-RAYS FROM TARGETS WITH VARIOUS Z VALUES. A. A. Rimskii-Korsakov and V. V. Smirnov (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 67-8(Jan. 1962). (In Russian)

The angular distributions of photoelectrons from Nd and U targets were measured. In conjunction with the data of a previous work it was possible to determine the Z dependence of the photoelectron flux at $\theta = 0$. (auth)

12297 ON FINITE AMPLITUDE WAVES IN MAGNETOHYDRODYNAMICS. Z. A. Gol'dberg (Magnetogorsk Teacher's Inst., USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 253-8(Jan. 1962). (In Russian)

Unidimensional waves moving perpendicularly to a magnetic field in a viscous heat and electric conducting medium are considered. Exact solutions are obtained for the magnetohydrodynamic equations in which terms linear and quadratic with respect to the Mach number are retained. It is demonstrated that all results of ordinary hydrodynamics apply. (auth)

12298 QUANTIZATION OF THE MAGNETIC FLUX FOR A SUPERCONDUCTING CYLINDER. V. L. Ginzburg (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 299-302(Jan. 1962). (In Russian)

The problem of quantizing magnetic flux in a superconducting cylinder of arbitrary thickness located in an external field is considered. (auth)

12299 ON THE IMPORTANCE OF THE EMISSION CHANEL FOR ION SOURCE. S. N. Popov (Inst. of Chemical Physics, Academy of Sciences, Moscow). Zhur. Tekh. Fiz., 31: 1431-8(Dec. 1961). (In Russian)

The results of investigations of the ion current dependence on potential and emission channel geometry indicate that the ion current from a plasma source is limited by space charge. The maximum ion flux for a given emission channel cross section is reached at V_a, where the plasma emission boundary is distributed inside the channel. The obtained data on the mean plasma density distribution and the electron temperature permits an approximate evaluation of the magnitude and density of the current in the channel and the efficiency of the working gas. (R.V.J.)

12300 ESTABLISHING OSCILLATING EQUILIBRIUM BEHIND A SHOCK WAVE. S. I. Anisimov (Inst. of Physics, Academy of Sciences, Belorussian SSR). Zhur. Tekh. Fiz., 31: 1491-3(Dec. 1961). (In Russian)

Numerical calculations of shock wave structure in a diatomic gas with damped oscillations, calculated with kinetic equations and resolved by squaring without simplification, are supplemented by integration with various assumptions, resulting in satisfactory approximation solutions. (R.V.J.)

12301 MOTION OF CHARGED PARTICLES IN HOMOGENEOUS MAGNETIC FIELD WITH LINEAR TIME DEPENDENCE. V. A. Ankudinov, V. M. Kel'man, O. M. Kresin, and L. N. Sysoeva (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 32: 22-9(Jan. 1962). (In Russian)

The motion of charged particles in a homogeneous, linear, time-dependent magnetic field is analyzed, assuming the central portion is asymmetrically produced by rounded loops or poles shaped as bodies of revolution. An r, φ, z, system was selected in which the z axis coincides with the symmetry axis. The magnetic field is parallel to z, with variations expressed by $H_z = H_0t + H_1$, where t is time and H_0 and H_1 are constants. An electron trajectory in a linearity increasing field, with H_0 increasing 2×10^7 gauss/sec and an initial $H_1 = 6.3$ gauss, is plotted. It is shown that the initial magnetic field delays the electron energy increase in fields with $H_z = H_0t + H_1$. (R.V.J.)

12302 STABILITY OF HEAVY CONDUCTING FLUID CONFINED BY FAST-ALTERNATING MAGNETIC FIELD. T. V. Volkov. Zhur. Tekh. Fiz., 32: 34-43(Jan. 1962). (In Russian)

The stability of a heavy conducting fluid with its gravity force contained by a rapidly-alternating magnetic field is analyzed, and stability criteria are derived considering surface tension and finite conductivity. The rate of flow increase by the field is also evaluated. (tr-auth)

12303 DEVELOPMENT OF SPARK DISCHARGE CHANNEL AT HIGH CURRENT RISE IN DISCHARGE

CIRCUIT. S. A. Andreev, M. P. Vanyukov, and A. B. Komolov. Zhur. Tekh. Fiz., 32: 57-62(Jan. 1962). (In Russian)

An apparatus with a resolving power of 10^{-9} sec was used for measuring the development of spark discharge, with a maximum current rise rate, in air. The obtained results are in good agreement with correlated theoretical calculations by S. I. Braginskii (Zhur. Eksptl. i Teoret. Fiz., 34: 1548, 1958). Channel expansion at a 10 to 12 km/sec rate was recorded. (R.V.J.)

12304 PRODUCTION OF CONVERGING CHARGED PARTICLE BEAM BANDS WITH HIGH CURRENT DENSITY. V. P. Ignatenko (Inst. of Mechanics, Academy of Sciences, Moscow). Zhur. Tekh. Fiz., 32: 63-8(Jan. 1962). (In Russian)

Production of wedge-shaped, high-intensity beams was studied in a cylindrical cathode system. It is shown that the rate of charged particle convergence varies with changes in anode shape. (tr-auth)

12305 EXCITATION OF ROTATING MOLECULES BEHIND A SHOCK WAVE. N. V. Krivtsova and Yu. P. Lun'kin (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 32: 69-75(Jan. 1962). (In Russian)

Variations in gas parameters during the excitation of molecules behind a shock wave are investigated. The width of the relaxation zone is sharply reduced with increased M numbers of the incoming flux. The influence of single-atom admixtures on the zone width is negligible. (tr-auth)

Astrophysics and Cosmology

12306 EQUILIBRIUM ABUNDANCES OF STABLE ISOTOPES. Hira Lal Duorah (Univ. of Delhi). Progr. Theoret. Phys. (Kyoto), 26: 844-50(Dec. 1961). (In English)

Equilibrium distribution calculated using the analogue of Saha's ionization formula is examined with the recent nuclear masses and abundance data. It is found that up to A = 92, the abundance distribution can be well reproduced. The electron degeneracy which becomes important is also considered for the region A = 64–92. The equilibrium temperature is found to be 6.5×10^9 degrees. The neutrality is taken to be satisfied by protons, neutrons, electrons, and alpha particles. The presence of positrons is not considered. Though effects of the excited levels are neglected, the differences between the even and odd nuclei are taken into account. (auth)

12307 INTERNAL STRUCTURE OF VERY MASSIVE STARS. Shiro Sakashita (Hokkaido Univ., Sapporo) and Chushiro Hayashi. Progr. Theoret. Phys. (Kyoto), 26: 942-6(Dec. 1961). (In English)

Models are computed for stars ($M = 46.8M_\odot$) consisting of four regions: a homogeneous radiative envelope, a semi-convective intermediate zone, a radiative intermediate zone, and a homogeneous convective core. The semi-convective intermediate zone is formed in the consequence of growing convective instability which is characteristic in very massive stars, and the distribution of composition in this region is determined so as to maintain the convective neutrality taking account of the effect of the gradient of mean molecular weight. It is shown that the very massive stars evolve essentially in the same way as less massive stars in their early phase, and the growing convective instability has little influence on the effective temperature and luminosity of stars. (auth)

12308 STELLAR SYNTHESIS OF THE PROTON-RICH HEAVY ELEMENTS. Kensai Ito (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 26: 990-1004(Dec. 1961). (In English)

Proton-rich heavy nuclei are produced by proton-capture and/or photo-nuclear reactions starting with the products of neutron capture. The stellar conditions in which the proton-rich nuclei are produced must be such that the proton density $\rho_p = 10 \sim 10^2$ gcm^{-3}, the neutron density $\rho_n = 10^{-5} \sim 10^{-4}$ gcm^{-3}, and the other matter density $\rho \lesssim 10^{-5}$ gcm^{-3} at the temperature $T = 2.5 \sim 3 \times 10^9$°K. It is, however, difficult to explain the abundance of all proton-rich nuclei for the equal temperature. It is possible if there exist regions of different temperature. To form these nuclei, the nuclear formation by the effective (γ,n) reaction occurs in the higher temperature region and the nuclear formation by the effective (γ,n) reaction in the lower temperature region. (auth)

12309 INVESTIGATIONS ON STONE METEORITES WITH EXTREMELY HIGH RARE GAS CONCENTRATIONS. I. THE PANTAR CHONDRITE. H. Koenig, K. Keil, H. Hintenberger, F. Wlotzka, and F. Begemann (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 16a: 1124-30(Nov. 1961). (In German)

Large amounts of excessive helium and neon were found in the veined chondrite Pantar. The absolute amounts as well as the isotopic compositions are similar to those found in Staroye Pesyanoe and Kapoeta. The meteorite shows light areas which are surrounded by dark regions. The dark color is caused by tiny veins mainly consisting of newly formed troilite, which presumably were produced during a thermometamorphosis and simultaneous addition of material. An investigation of the separated fractions shows the excessive helium and neon to be contained almost completely within the dark fraction, i.e., the part of the meteorite which has undergone severe metamorphic changes. The ammonium content of Pantar is the same as that of other chondrites. Problems related to the existence of primordial gases in meteorites are discussed in view of the results presented. (auth)

Cosmic Radiation

12310 (NYO-10126) A SEARCH FOR HIGH ENERGY COSMIC GAMMA RAYS IN EMULSIONS. J. Klarmann (Rochester, N. Y. Univ.). Feb. 16, 1962. Contract AT (30-1)-875. 15p.

The possibility of employing nuclear emulsions as a detector for gamma radiation from celestial sources was tested in a balloon flight over Texas. An average downward flux of 0.27 photons/cm^2 sec steradian was found during ascent and descent of the balloon in a solid angle of 0.842 steradian. An upper limit to the flux of gamma rays at an altitude of between 3 and 4.5 gm/cm^2 was determined as 1.7×10^{-2} photons/cm^2 sec steradian. An upper limit to the albedo flux during ascent and descent is given by 2.5×10^{-2} photons/cm^2 sec steradian. The results on scanning time and scanning efficiency in Ilford G-5 emulsions were not too encouraging. (auth)

12311 DETECTION OF AN INTENSE FLUX OF LOW-ENERGY PROTONS OR IONS TRAPPED IN THE INNER RADIATION ZONE. John W. Freeman (State Univ. of Iowa, Iowa City). J. Geophys. Research, 67: 921-8(Mar. 1962).

Employing a set of CdS crystal energy-flux detectors flown in satellite Injun I, an energy flux in excess of 50 ergs/cm^2 sec sterad was observed at approximately 1000 km altitude in the inner Van Allen zone. Through discrimination by magnetic rigidity and with the help of data

from other on-board detectors, it was found that the flux is comprised of protons of energy 0.5 kev $\lesssim E \lesssim$ 1 Mev and/or other heavy ions, apparently trapped in the geomagnetic field. So large a flux of low-energy heavy particles seems inconsistent with current hypotheses on the source function and/or the trapped lifetime of such particles. (auth)

12312 ROCKET OBSERVATIONS OF SOLAR PROTONS DURING THE NOVEMBER 1960 EVENTS, 1. K. W. Ogilvie, D. A. Bryant, and L. R. Davis (National Aeronautics and Space Administration, Greenbelt, Md.). J. Geophys. Research, 67: 929-37(Mar. 1962).

Results of three Nike-Cajun rocket flights made during the November 12, 1960, solar proton event are described. Using Geiger and scintillation counter measurements, the proton spectrum was extended downward to 0.2 Mev. Particles at 0.2 to 1 Mev were found; this group may not be part of the flare-accelerated spectrum, but may be associated with the plasma in the earth-sun region. The spectrum in the low-energy region above 1 Mev cannot be represented by a simple extrapolation of the spectrum at higher energies as observed, for instance, using balloons. (auth)

12313 THE DISTRIBUTION OF ELECTRONS IN THE NIGHTTIME IONOSPHERE. Audrey R. Long (Cavendish Lab., Cambridge, Eng.). J. Geophys. Research, 67: 989-97(Mar. 1962).

The mean night-time electron density all over the world at heights below the peak of the F_2 layer in the quiet ionosphere was deduced from an analysis of ionosonde data. Results are more accurate than any hitherto available, since a method of analysis was used in which the low-lying ionization, corresponding to a plasma frequency below the lowest frequency for which echoes are observed, is considered. It was predicted that ionization in the night-time ionosphere would assume an 'α-Chapman' distribution. Results of this survey show that experimental observations of the electron density-height profiles are in close agreement with these predictions. The observed form of the variation of the electron density at fixed heights with latitude at night shows little or no seasonal effects and differs considerably from the daytime form. These latitude distributions remain quantitatively unexplained. (auth)

12314 PHOTOIONIZATION RATES IN THE E AND F REGIONS. K. Watanabe (Geophysics Corp. of America, Bedford, Mass.) and H. E. Hinteregger. J. Geophys. Research, 67: 999-1006(Mar. 1962).

Photoionization rates at 90 to 400 km altitude computed using recent data on solar ultraviolet intensities are up to two orders of magnitude larger than previous values. Results contradict the theory that E-region ionization is due predominantly to soft x rays; observed radiation at 800 to 1027 Å that ionizes O_2 contributes a greater or comparable photoionization rate. The base of the E region is probably controlled by Lyman β and the C III line at 977 Å. The electron production in the F region is primarily due to ultraviolet radiation at 170 to 900 Å. At sunrise the maximum ionization rate is at about 320 km but descends to about 150 km for zenith sun. The F_1 ledge probably follows this maximum and descends to about 150 km. The F_2 peak is apparently due to the combined result of the daytime enhancement of electron density and the slow recombination. (auth)

12315 A POSSIBLE CORRECTION TO THE SPECTRUM OF GEOMAGNETICALLY TRAPPED PROTONS. G. Haerendel (Max-Planck-Institut für Physik und Astrophysik, Munich). J. Geophys. Research, 67: 1173-4(Mar. 1962).

In determining the mean atmospheric density encountered by a particle, gyrations cannot always be ignored by averaging the density simply over the path of the guiding center. The density is also a function of the energy. Protons below 100 Mev have gyroradii comparable to the scale height of the nitrogen-oxygen component of the atmosphere. Corrections are calculated, and results are presented in graphical form. The effect depends sensitively on position and scale height. (L.N.N.)

12316 ON A G. M. COUNTING RATE INCREASE RECORDED AT BALLOON ALTITUDE. D. Brini (Università, Bologna), M. Galli, G. L. Tabellini, U. Ciriegi, and A. Gandolfi. Nuovo cimento (10), 22: 1261-6(Dec. 16, 1961). (In English)

A fast pulse of G-M counts was recorded in a balloon flight, near Bologna, under 120 g cm^{-2} of residual atmosphere, between 0712 UT and 0714 UT on July 18, 1961, during relatively high solar activity. In about two minutes, the count-rate rose and decayed again to the normal value, reaching a maximum about 50% higher than the value corresponding to the absence of solar activity. Solar geophysical events of this period and the possible causes of the counting burst are considered. Because of the peculiarity of the event, it is difficult to state the type of particle responsible. Among all the possible causes, the least improbable are solar photons at 1 to a few 100 Mev or 4 to 8 Bev. (auth)

12317 IONIZED GAS AND FAST ELECTRONS IN THE VICINITY OF THE EARTH AND IN INTERPLANETARY SPACE. K. I. Gringauz, V. G. Kurt, V. I. Moroz, and I. S. Shklovskii. Planetary and Space Sci., 9: 21-5(Jan.-Feb. 1962). (Translated by R. Matthews from Iskusst. Sputniki Zemli, No. 6, p.108, 1961).

Data from the second Soviet space rocket are analyzed. Ion concentrations are evaluated from collector-current data from traps; knowledge of the container electric potential is important. Current variations in a "+15 v" trap are analyzed. Space distributions of radiation belts surrounding the earth are proposed. It is suggested that the soft-electron concentration has a minimum in the radiation-belt zones. Plasma ion concentrations are evaluated from indications of a zero-potential trap. Assuming the plasma ions to be protons, thermal velocities are near the container velocity. Data indicate that the investigated plasma is not interplanetary ionized gas. It is concluded that the zodiacal-light polarized component is due to sunlight scattering by dust particles and not free electrons. (L.N.N.)

12318 THE DETECTION OF ELECTRONS WITH ENERGIES OF APPROXIMATELY 10 keV IN THE UPPER ATMOSPHERE. V. I. Krasonskii, I. S. Shklovski, Yu. I. Gal'perin, E. M. Svetlitskii, Yu. M. Kushnir, and G. A. Bordovskii. Planetary and Space Sci., 9: 27-40(Jan.-Feb. 1962). (Translated by R. Matthews from Iskusst. Sputniki Zemli, No. 6, p.113, 1961).

Fluxes were measured at up to 1900 km in the southern area of the Pacific Ocean. Intensities were very high; instrument readings usually overshot the scale. Flux intensity tended to increase with effective energy of the particles. Effective energies were lower in the polar regions. Recorded fluxes were explained by the electron oscillatory motion along the magnetic lines of force. (L.N.N.)

12319 SHORT-TERM INCREASES IN THE INTENSITY OF THE NUCLEAR COMPONENT OF COSMIC RAYS ASSOCIATED WITH SOLAR ACTIVITY. L. V. Kurnosova,

L. A. Razorenov, and M. I. Fradkin. Planetary and Space Sci., 9: 41-6(Jan.-Feb. 1962). (Translated by R. Matthews from Iskusst. Sputniki Zemli, No. 6, p.132, 1961).

Cosmic nuclei were investigated at relativistic velocities using Cherenkov counters. Counting rates beyond the outer belt remained practically constant over long periods of time but deviated considerably from the mean during short intervals. Comparisons with solar activity were made and relations were observed. Data are presented in graphical form. (L.N.N.)

12320 THE 27-DAY PERIOD OF COSMIC RADIATION. W. Zwanzig (Universität, Halle, Ger.). Z. Naturforsch., 16a: 1237-9(Nov. 1961). (In German)

The existence of a persistent 27.2-day wave in the intensity of cosmic radiation was proved. (tr-auth)

12321 NEUTRINO PRODUCTION IN THE ATMOSPHERE. G. T. Zatsepin and V. A. Kuzmin (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 1818-27(Dec. 1961). (In Russian)

The energy spectra and angular distributions of neutrinos produced in the atmosphere in the decays $\pi \rightarrow \mu + \nu$ and $\mu \rightarrow e + \nu + \bar{\nu}$ are calculated by taking into account the μ meson energy losses at neutrino energies $\epsilon = 10^9$ to 3×10^{11} ev. It is shown that the neutrino flux from $\mu \rightarrow e + \nu + \bar{\nu}$ decays is comparable with that from the $\pi \rightarrow \mu + \nu$ decay. μ meson energy losses only weakly affect neutrino production. K mesons produce neutrinos more efficiently than do π mesons. An experimental arrangement for recording high energy cosmic ray neutrinos is proposed. (auth)

12322 INVESTIGATION OF THE POLARIZATION OF COSMIC RAY μ^+-MESONS. A. I. Alikhanyan, T. L. Asatiani, E. M. Matevosyan, and R. O. Sharkhatunyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Zhur. Eksptl'. i Teoret. Fix., 42: 127-9(Jan. 1962). (In Russian)

Polarization of underground cosmic μ^+ mesons was investigated for a mean (with respect to the angular distribution) minimum momentum of 2.3 Bev/c. The polarization was determined on the basis of asymmetry in the angular distribution of positrons emitted by decaying μ^+ mesons in a copper absorber. 16290 decay events without a field and 14920 events with a depolarizing magnetic field of 80 gauss were observed. The polarization value is $P = 0.25 \pm 0.03$. The exponent in the π-meson production spectrum was determined. (auth)

12323 ON THE INTERPRETATION OF THE TWO-CENTER MODEL WITHIN THE FRAMEWORK OF THE HYDRODYNAMIC THEORY. A. A. Emel'yanov (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 171-2(Jan. 1962). (In Russian)

It is suggested that double-humped showers should be described within the framework of hydrodynamic theory by taking into account the energy dissipation of a simple wave resulting from the effect of viscosity. (auth)

Criticality Studies

Refer also to abstracts 12649, 12698, 12699, 12700, 12701, and 12702

12324 (NAA-SR-6608) CRITICAL LOADING EXPERIMENT FOR THE SRE WITH THORIUM–URANIUM FUEL. R. Garcia and R. L. Lewis (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 1, 1962. Contract AT(11-1)-GEN-8. 21p.

The minimum critical loading of the SRE with Th–U fuel and Na in the core at 340°F was found to be 30.6 ± 0.2 fuel clusters. The operational loading, defined as criticality with two of the four shim rods in the core, was found to be 40.6 ± 0.2 fuel clusters. An evaluation of various plotting techniques for critical experiment data is given. It was found that plotting the inverse multiplication as a function of radial buckling, using the physical radius plus reflector savings, gave the most linear approach to criticality. (auth)

12325 (PG-Report-97(2nd Ed.)) AN EMPIRICAL CORRELATION OF THE EXPERIMENTAL DATA ON HOMOGENEOUS CRITICAL ASSEMBLIES OF URANIUM AND HYDROGEN OF ALL ENRICHMENTS. B. G. Owen (United Kingdom Atomic Energy Authority. Production Group, Risley, Lancs, England). Nov. 1960. 37p.

The original correlation on highly enriched uranium–hydrogen critical systems is now extended to all enrichments. By using three empirical equations and the one-group buckling relations, the physical size of any uranium–hydrogen homogeneous critical assembly in simple geometry can be predicted. The predictions are compared with experiment where experimental data are available. The experimental data are of fissile solutions and intimate wax compacts using uranium compounds. The correlation, at present, must be confined to those conditions until more experimental data are available. The derived reflected spherical mass and volume is displayed in universal terms. The reflected infinite cylinder and slab dimensions are displayed graphically. (auth)

12326 THE MEASUREMENT OF ETA AND OTHER NUCLEAR PROPERTIES OF U^{233} AND U^{235} IN CRITICAL AQUEOUS SOLUTIONS. R. Gwin and D. W. Magnuson (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 12: 364-80(Mar. 1962).

The thermal value of eta for U^{233} and U^{235} is determined in experiments on unreflected homogeneous aqueous solutions of the two isotopes. These experiments also yield a value for the neutron age and the limiting concentrations of the fissile isotope in the aqueous solutions for infinite volumes. Auxiliary experiments, establishing limits of error, testing certain aspects of the theoretical model employed, and experimentally determining the parameters in the critical equation, are also performed. Experiments performed with 27-in.- and 48-in.-diam spheres, and 5-ft- and 9-ft-diam cylinders yield consistent values of eta. Measurements of the nonleakage probability in cylindrical geometry give values consistent with those predicted by a two-group model in which the theoretical value of the age is used. Within the experimental error no differences are found in the ages of fission neutrons for U^{233} and U^{235}. The average thermal values of eta determined are 2.292 ± 0.015 for U^{233} and 2.076 ± 0.015 for U^{235}. The 2200 meters/sec values are the same since the g-factors for eta are unity. The value of the neutron age to the indium resonance energy for U^{238} fission neutrons in water is found to be 25.6 ± 1.3 cm^2. The minimum U^{233} and U^{235} critical densities for these nitrate solutions are found to be 11.25 ± 0.10 and 12.30 ± 0.10 gm/liter for U^{233} and U^{235}, respectively. (auth)

Elementary Particles and Radiations

12327 (AD-259857) THE ELASTIC SCATTERING OF LOW ENERGY ELECTRONS BY THE SLATER ORBITAL ATOM. Lawrence Baylor Robinson (Aerospace Corp., El

Segundo, Calif.). Mar. 13, 1961. Contract AF04(647)-594. 50p. (TDR-594(1203-01)TR-1)

The potential between an electron and a static atom is formulated on the basis of screening-constant-type wave functions characteristic of the Slater orbital atom. Universal functions are constructed to characterize any atom with atomic number Z from 1 to 86. The low-energy elastic scattering properties of atoms are investigated on the basis of such a potential, and the cross sections are calculated from phase shifts. Scattering lengths are calculated from all of the atoms from Z = 1 to Z = 86. The results are compared with those which were obtained with the Thomas-Fermi model of the atom. Results are given for the cross sections as a function of energy in some specific cases. Qualitative agreement between theory and experiment results from such calculations. A polarization potential must be added to static atom potentials in order to obtain quantitative agreement between theory and experiment. (auth)

12328 (AD-259872) UNIQUENESS THEOREMS UNDER THE RADIATION CONDITION. Technical Report No. 8. Farouk M. Odeh (California. Univ., Berkeley. Dept. of Mathematics). Aug. 1960. Contract Nonr-222(60). 74p.

Uniqueness and existence theorems are given for the solutions of the time-independent Schroedinger's equation which satisfy Sommerfeld's radiation condition. It is shown that, under appropriate conditions, the radiating solution is the limit of the initial value solution of the time-dependent equation as the time grows indefinitely. It is also shown that the L2-solutions of the Schroedinger equation with imaginary energy tend to the radiative solution if the imaginary part of the energy tends to zero. The radiation condition is shown to ensure uniqueness of the solutions to some electromagnetic problems involving infinite boundaries. (auth)

12329 (D1-82-0119) BOSE SYSTEMS WITH ATTRACTIVE INTERACTIONS. Fluid Physics Group Report No. 43. M. Girardeau (Boeing Scientific Research Labs., Seattle). June 1961. 19p. (AD-261149)

Considerations are given for the treatment of a helium-4 many-body system for interactions at low densities and negative scattering lengths. The considerations are restricted to the Fermi pseudopotential approximation, and to densities so low that only the first-order term in the energy equation is felt to be of importance. (B.O.G.)

12330 (ISS-61/14) CINEMATICA DELLA FOTOPRODUZIONE DEI Λ^0e DEI K^+ IN IDROGENO TRA 925 E 1500 MEV. (Kinematics of the Photoproduction of Λ^0 and K^+ in Hydrogen Between 925 and 1500 Mev). G. Campos Venuti (Italy. Istituto Superiore di Sanità, Rome). [nd]. 26p.

The K^+ and Λ^0 angular and energy distributions from the reaction $\gamma + p \rightarrow K^+ + \Lambda^0$ are calculated as functions of the incident γ energy. The results are tabulated in 25-Mev γ energy increments, from 925 to 1500 Mev. (T.F.H.)

12331 (ISS-61/21) CINEMATICA DELLA DIFFUSIONE ELASTICA DI γ IN IDROGENO (EFFETTO COMPTON) TRA 300 E 1500 MEV. (Kinematics of the Elastic Scattering of γ in Hydrogen (Compton Effect) Between 300 and 1500 Mev). P. Salvadori (Italy. Istituto Superiore di Sanità, Rome). [nd]. 51p.

The proton (p') and γ' energy and angular distributions from the elastic (Compton) interaction $p + \gamma \rightarrow p' + \gamma'$ are calculated. The results are tabulated for 25-Mev γ increments, from 300 to 1500 Mev. (T.F.H.)

12332 (JINR-D-824) NOTE ON THE MASS SPECTRUM OF ELEMENTARY PARTICLES. P. S. Isaev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 4p.

An investigation was made to determine if decay regularity is kept in the unstable particles observed in the interaction of π and K mesons with baryons. In almost all cases the old regularity was conserved. (M.C.G.)

12333 (JINR-P-226) POLYARIZATSIONNYE EFFEKTY PRI OBRAZOVANII MEZONOV NUKLONAMI. OBZOR. (Polarization Effects in Meson Production by Nucleons. (Review)). L. M. Soroko (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1958. 56p.

Data are given on some phenomenological theories of meson production by nucleons and on nucleon inelastic interaction experiments. The theory of meson formation by nucleons near the threshold, the resonance phenomenological theory of meson production by nucleons at 400 to 900 Mev, the general theory of nuclear reactions with nucleon interaction processes followed by meson emission, and the interactions of proton with protons at 400 to 900 Mev are analyzed, as well as the processes $p + p \rightarrow d + \pi^+$ and $p + p \rightarrow \pi + n + n$. (R.V.J.)

12334 (JINR-P-839) OPREDELENIE ISTINNOGO CHISLA SOBYTII I EGO FLUKTUATSII PO REZUL'TATAM DVUKH NEZAVISIMYKH NABLYUDENII. (Determination of Virtual Number of Events and its Fluctuations due to two Independent Observations). M. I. Podgoretskii and E. N. Tsyganov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 8p.

The mean magnitude, H, and fluctuations N, E_1, E_2, and E (where E, E_1, and E_2 are the recorded events) were determined by two independent observations on photoemulsions and by determining the virtual number of decays by β-γ coincidence. (R.V.J.)

12335 (JINR-P-840) OB ODNOI VOZMOZHNOSTI OPREDELENIYA MAGNITNYKH MOMENTOV VEKTORNYKH NESTABIL'NYKH CHASTITS. (On One Possibility of Determining Magnetic Moments in Vectoral Unstable Particles). A. M. Baldin and Nguen Van Kh'eu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 6p.

The vector character of some unstable particles was determined, and the anomalous magnetic moments were found. The photoproduction of unstable particles with spin = 1 is analyzed, considering published postulations on K' particles, K-π resonance, and π-π resonance. (R.V.J.)

12336 (KFK-80) DOES THE ROSENBLUTH FORMULA BREAK DOWN? Herwig Schopper (Kernforschungszentrum. Institut für Experimentelle Kernphysik, Karlsruhe, Germany). Jan. 1962. 5p.

A note is presented to show that presently known results on electron-proton scattering are in principle sufficient to prove a breakdown of the Rosenbluth formula for q > 30 $fermi^{-1}$. (J.R.D.)

12337 (NP-11175) SCATTERING OF K^- MESONS BY NUCLEI [thesis]. Technical Report No. 29. Jack Harley Hetherington (Illinois. Univ., Urbana). Dec. 1961. Contract ONR 1834(05). 208p.

A discussion is presented of problems for computing the differential cross sections for charged spin-zero mesons from a given optical potential, and for the calculation of the optical potentials expected for various solutions. Descriptions are given of derivations of equations for the scattering amplitudes, total reaction cross sections, and optical potentials, and of the computer programs for obtaining solutions to the equations. (B.O.G.)

12338 CRITICAL COMMENTS ON THE INVESTIGATION OF THE ELECTRON-NEUTRINO ANGULAR CORRELATION BY THE CLOUD CHAMBER METHOD. A. Szalay, J. Csikai, and J. Bacsó (Inst. of Nuclear Research, Academy of Sciences, Debrecen, Hungary). Acta Phys. Acad. Sci. Hung., 13: 437-45(1961). (In English)

Problems arising from the measurement of the angular correlation between an electron and neutrino by the cloud chamber method are reported. On the ground of a critical evaluation of the method, earlier data for e−ν angular correlation were revised. The value +0278 ± 0242 was obtained for the angular correlation coefficient. Because of the great statistical error it is impossible to give preference to either the tensor or the axial forms of interaction. (auth)

12339 THE ELECTRON ABSORPTION OF POSITIVE μ MESONS. Viktor Gorgé (Universitilt, Bern). Helv. Phys. Acta, 34: 629-34(1961). (In German)

The possibility of an absorption reaction for the μ-e bound state similar to the absorption reaction for the μ mesic atom is analyzed. The forbiddenness of electron absorption depends on the existence of the neutrino-free decay $\mu \rightarrow e + \gamma$, which assumes the identity of the neutrinos and is strongly dependent on the existence and the electrical properties of a hypothetical intermediary boson. The (non-observable) annihilation of the μ-e system into two neutrinos, which results directly from the μ decay, is however, not known. The extreme improbability of this "permitted" process in comparison with μ^- capture is shown. (J.S.R.)

12340 RADIATION FROM SUPER-LIGHT VELOCITY CHARGED PARTICLES AND ITS UTILIZATION IN HIGH-ENERGY PARTICLE PHYSICS. P. A. Cherenkov. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 14-20(Jan. 1962). (In Russian)

The design and applications of counters using super-light velocity charged particles are reviewed. A scheme with conic emission, with particles moving from the apex to the base, and the design of a spherical image from fast particle emission in a plane perpendicular to the particle motion are presented, as well as the design of a von Dardel fast particle gas counter and an antiproton counter. (R.V.J.)

12341 REVERSE PROBLEM FOR QUANTUM MECHANICS EQUATION. V. I. Mal'chenko (Dnepropetrovsk State Univ., USSR). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 4, 28-9(1961). (In Russian)

A reverse problem in quantum mechanics is analyzed, and the scattering potential is determined using known elastic scattering amplitudes $f(k,\tau)$ of quantum mechanical particles. (R.V.J.)

12342 SCATTERING OF CHARGED PARTICLES IN HOMOGENEOUS MAGNETIC FIELD WITH CENTRAL POTENTIAL. V. M. Eleonskii (Kirov Ural Polytichnic Inst., USSR). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 4, 30-6(1961). (In Russian)

An expression is derived for the space-time Feynman function for a particle in a homogeneous magnetic field, and its asymptotic was analyzed. An explicit expression was found for matrix element transition between integral states for screened scattering Ukawa-type potential. The asymptotic transition probabilities are analyzed. (tr-auth)

12343 GREEN'S FUNCTIONS IN NON-LINEAR FIELD THEORY. A. M. Brodskii and Yu. I. Gubar (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 4, 71-8(1961). (In Russian)

An equation for a two-term Green's function is derived, and the generalized vertex part and analog for a Green's function boson are determined, considering the boson as the result of two-fermion fusion. (R.V.J.)

12344 BACK-SCATTERING OF MEGAVOLT ELECTRONS FROM THICK TARGETS. Kenneth A. Wright and John G. Trump (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 33: 687-90(Feb. 1962).

Measurements of the number and energy of the electrons which rebound from thick metal targets bombarded at normal incidence by monoenergetic electrons of from 1 to 3 Mev are reported. The ratio of back-scattered to incident electron current, measured for twelve metal targets, was found to vary from 0.47 for 1-Mev electrons incident on U to 0.01 for 3-Mev electrons on Be. The total energy scattered backward from targets of Al, Cu, and Pb bombarded with 1- to 3.5-Mev electrons was determined by calorimetric methods. This energy diminished from 34% of the incident energy for Pb bombarded with 1-Mev electrons to 1% for Al bombarded with 3.5-Mev electrons. The dependence of the number and energy of the back-scattered electrons on the atomic number of the target and on the incident electron energy is discussed. (auth)

12345 THE INVARIANT IMBEDDING METHOD FOR TRANSPORT PROBLEMS. II. RESOLVENT IN PHOTON DIFFUSION EQUATION. Sueo Ueno (Kyoto Univ.). J. Math. Anal. and Appls., 3: 361-72(Oct. 1961).

From a probabilistic viewpoint, the equation $K(\tau,\tau') = \Psi(\tau' - \tau) + \int_0^\tau \Psi(t)\Psi(t + \tau' - \tau)dt$ is derived. Using an invariant imbedding technique, the stochastic integro-differential equation governing the emission probability distribution is derived and combined with the photon diffusion equation established from the probabilistic viewpoint. The equation determining the resolvant in the photon diffusion equation is obtained, and the resolvant is expressed in terms of the auxiliary function $\Psi(\tau)$ depending only upon the one-level argument. Thus the Milne first integral equation in the radiative transfer and neutron diffusion theories can be solved without referring to the iterative procedure. (L.N.N.)

12346 SPIN AND STATISTICS WITH AN ELECTROMAGNETIC FIELD. David G. Boulware (Harvard Univ., Cambridge, Mass.). J. Math. Phys., 3: 50-8(Jan.-Feb. 1962).

The connection between spin and statistics is proved in the presence of an electromagnetic field. Two functions, corresponding to the Wightman functions for the two orderings of Lorentz gauge operators, are exhibited as expectation values of radiation gauge operators. These are Lorentz invariant and have the requisite positive frequency characteristics. The radiation gauge commutation relations on an x^0 = const surface imply that the corresponding Lorentz gauge functions vanish for spacelike separations. Assuming the "wrong" connection between spin and statistics, the anticommutator functions are zero and continue to the origin. At the origin, the Lorentz gauge functions are simply the radiation gauge operator expectation values. Hence, the wrong commutation relations imply the vanishing of the radiation gauge field anticommutator at the origin, which is inconsistent with a positive definite metric and a nonvanishing field. (auth)

12347 CAUSALITY AND THE R MATRIX. M. E. Ebel (Univ. of Wisconsin, Madison). J. Math. Phys., 3: 68-9 (Jan.-Feb. 1962).

A counterexample to the theorem that causality and unitarity alone will guarantee that the R matrix has no singularities off the real energy axis is considered and shown to come from an acausal interaction. The nature of

the acausality in this model and in some trivial generalization is also discussed. (auth)

12348 CONSTRUCTION OF POTENTIALS FROM THE PHASE SHIFTS AT FIXED ENERGY. Roger G. Newton (Indiana Univ., Bloomington). J. Math. Phys., 3: 75-82 (Jan.-Feb. 1962).

The nonrelativistic potential energy between two spinless particles is deduced from a knowledge of all phase shifts at a given energy. A spherically symmetric potential is found always to exist, but it is not unique. For every energy, there exists at least one nonzero potential which causes the scattering cross section to be zero. The formal construction procedure and the necessary existence and uniqueness (or lack of it) proofs are presented. General examples are included. (auth)

12349 SMALL ANGLE X-RAY SCATTERING FROM RANDOMLY ORIENTED CYLINDERS OF ARBITRARY CROSS SECTION. Akeley Miller and Paul M. Schmidt (Univ. of Missouri, Columbia). J. Math. Phys., 3: 92-6 (Jan.-Feb. 1962).

At the larger angles of the small-angle region, asymptotic expansions are the appropriate means of calculating the intensity of the small angle x-ray scattering from identical particles with uniform electron density and random position and orientation. Since it was shown that this intensity can be expressed as a Fourier integral transform involving a function characteristic of the size and shape of the particles, standard techniques for asymptotic expansion of Fourier integrals can be employed. Right cylinders of arbitrary cross section were chosen. These generalized cylinders permit a fairly wide range of choice of particle shape and are well adapted to the study of both elongated and flattened particles. An integral was developed which gives the characteristic function for the generalized cylinder in terms of the characteristic function of the two-dimensional cross section of the cylinder. As the asymptotic expressions for the scattered intensity depend critically on the discontinuities in derivatives of the characteristic function, a study was made of these derivatives. An expression for the scattered intensity from rectangular parallepipeds was calculated. A treatment of the limiting case of highly elongated cylinders is given. (auth)

12350 EIGENVALUES AND EIGENVECTORS OF A SYMMETRIC MATRIX OF 6j SYMBOLS. Morris E. Rose and C. N. Yang (Brookhaven National Lab., Upton, N. Y.). J. Math. Phys., 3: 106(Jan.-Feb. 1962). (BNL-5583)

A real orthogonal symmetrical matrix M is defined. It represents the transformation between two coupling schemes for the addition of the angular momenta b, a, b to form a'. The eigenvectors and eigenvalues of M are found. A physical application is discussed. (auth)

12351 A SELF-CONSISTENT CUT-OFF AND A BARYON-MESON MODEL. E. Van Der Spuy (Oak Ridge National Lab., Tenn.). Nuclear Phys., 29: 400-41(Jan. 1962). (In English)

A heuristic approach leads to a suggested fundamental non-linear dynamical equation for a neutral nucleon field operator in Heisenberg representation. Analysis leads to an equation in momentum space that the fermion propagator must satisfy in a self-consistent manner. This specifies a self-consistent cut-off with at least two additional masses, a ghost one and a real one. To interpret this, the Sakata compound model is introduced for the baryon-meson system and extended for reasons of symmetry. A general formally symmetric strong coupling is introduced and discussed. The resultant modification of the fundamental non-linear dynamical equation is then used with the τ-function formalism to generate, in the lowest approximation, the equation of motion of a single baryon, a single meson, and the baryon-baryon interaction. For the lowest approximation for the baryon propagation, a suggested self-consistent baryon propagator is numerically related to the normalization constants, the coupling constant, and the mass of the possible meson doublet which the lowest approximation indicates. The significance of this mass doublet is discussed, and the corresponding magnitude of the typical nuclear forces outside the nucleon core is given in the lowest approximation. (auth)

12352 COMPLEX PHASE SHIFTS AND PERIPHERAL PROCESSES IN N-N SCATTERING. R. J. N. Phillips (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 30: 148-53(Feb. 1962). (In English)

It is argued that the imaginary parts of higher phase shifts are related to inelastic peripheral collisions. An estimate at 660 Mev indicates that phase shifts are essentially real for $J > 5$, which would simplify an analysis. Complex phase shift analysis is discussed. (auth)

12353 BACKSCATTERING OF GAMMA RAYS. Tomonori Hyodo (Kyoto Univ.). Nuclear Sci. and Eng., 12: 178-84(Feb. 1962).

Spectra of backscattered radiation from semi-infinite slabs of paraffin, aluminum, iron, tin, and lead were measured by means of a scintillation spectrometer, as a function of the measuring angle θ, which is the angle between the normal to the plane face of the slabs and the detector axis. The point gamma sources of Co^{60} and Cs^{137} were placed in close contact with the scattering slabs. By using this geometry the measurement was performed without perturbing effects produced by detector or source collimating shields. The energy and number albedos, the angular distributions of scattered energy and number of photons, and the energy distributions are given for each combination of gamma source and scatterer. (auth)

12354 ANGULAR CORRELATIONS IN $K^- + p \rightarrow \Lambda^0 + \pi^+ + \pi^-$. B. Sakita (Univ. of Wisconsin, Madison). Nuovo cimento (10), 22: 1113-23(Dec. 16, 1961). (In English)

Angular correlations in the $K^- + p \rightarrow \Lambda^0 + \pi^+ + \pi^-$ process are investigated in terms of the Λ-π resonance (Y^*) isobar model. Two regions of the incident K-meson energy are considered: one gives separated bands in the Dalitz plot; the other gives overlapped bands. If the produced Y^* is polarized for the separated case, it is shown that the forward-backward and outward-inward decay asymmetries of the Λ^0 give useful information to determine the spin and parity of the Y^*. For the overlapped case, it is shown that there is up-down asymmetry of Λ decay with respect to the plane containing Λ^0, π^+, and π^- in the center-of-mass system, and this asymmetry gives information to determine the parity of Y^*. (auth)

12355 INTERACTIONS OF 1.15 GeV/c K^- MESONS IN EMULSION. [PART] III. C. M. Garelli, A. Marzari Chiesa, G. Rinaudo, and M. Vigone (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nuovo cimento (10), 22: 1152-9(Dec. 16, 1961). (In English)

Previous results concerning emission of charged Σ hyperons from K^- interactions are presented. Experimental energy distributions are discussed, and explanations considering processes inside the nucleus are offered. (auth)

12356 MASS DIFFERENCE OF NEUTRAL K MESONS. V. L. Fitch (Princeton Univ., N. J.), P. A. Piroué, and

R. B. Perkins. Nuovo cimento (10), 22: 1160-70(Dec. 16, 1961). (In English)

The mass difference ΔM between K_1^0 and K_2^0 mesons was investigated by producing K^0 mesons and observing the $\overline{K}^0$ component of the K^0-$\overline{K}^0$ admixture as a function of time. The $\overline{K}^0$'s were sampled by using the charge exchange process and detecting the resulting K^- mesons. The best value for the mass difference is $\Delta M = 1.9 \pm 0.3\hbar/\tau_1 c^2$, where τ_1 is the mean life of the K_1^0. Selected high mass-differences ($\Delta M > 10$) are also consistent with the data. (auth)

12357 MESIC DECAYS OF HYPERNUCLEI FROM K^- CAPTURE. III. CHARACTERISTICS OF THE PARENT STARS. D. Abeledo (Northwestern Univ., Evanston, Ill.), L. Choy, R. G. Ammar, N. Crayton, R. Levi Setti, M. Raymund, and O. Skjeggestad. Nuovo cimento (10), 22: 1171-96(Dec. 16, 1961). (In English)

Capture stars (422 K^- and 13 Σ^-) emitting mesic hyperfragments (MHF) were studied in an attempt to understand the mechanism of hyperfragment production. Stars emitting Li^8 (123 K^-) fragments were also considered. Criteria used to separate K^- captures in C, N, O, and AgBr are discussed. Lower limits for the proportion of MHF produced in C, N, and O are 57, 73, 84, and 94% for H_Λ, He_Λ, Li_Λ, and MHF of $Z \geq 4$. For Li^8, this lower limit is 75%. Over-all frequencies of $(1.05 \pm 0.05) \times 10^{-2}$ MHF/K^--capture and $(3.8 \pm 1.4) \times 10^{-2}$ HF/Σ^--capture were obtained. The energy spectrum of the pions emitted in the capture stars indicates that a substantial fraction of the emitted bound Λ's originates in Σ-conversion processes. Indication of bound-Λ production from multinucleon K^--capture processes was obtained, important in the case of H_Λ. The momentum spectra for different hypernuclear species are similar, and the spectra of He_Λ and Li_Λ are, in turn, comparable with the momentum spectra of He and Li^8, respectively. Hyperfragments are emitted preferentially opposite to the direction of emission of an associated pion or fast proton. The backward-forward (B/F) ratio is for π, MHF events, 1.8 ± 0.4. Two models for the production of hyperfragments are proposed. According to the first ("trapped-Λ") the Λ created in the elementary process is trapped in the nuclear potential well of the parent nucleus. The HF is then emitted in the process of nuclear de-excitation. In the second model ("prompt-HF") the HF is emitted promptly following the K^- or Σ^- interaction with a group of nucleons. It is concluded that both mechanisms may contribute. The occurrence of both processes can explain the salient features of hyperfragment emission. (auth)

12358 CHARACTERISTICS OF Λ^0 PRODUCED IN CARBON NUCLEI BY 1.3 GeV π^-. R. Cester (Istituto Nazionale di Fisica Nucleare, Turin and Princeton Univ., N. J.). Nuovo cimento (10), 22: 1267-83(Dec. 16, 1961). (In English)

Polarization of Λ^0 produced in carbon was derived from the measurement of decay asymmetries. This was done on 238 events originated by π^- of 1.3 and 1.2 Bev. The up-down asymmetry measured with respect to the plane $P_{\pi inc} \times P_{\Lambda^0}$ is $\overline{\alpha P_0} = -0.018 \pm 0.107$; the asymmetry (left-right) measured with respect to the plane $(P_{\pi inc} \times P_{\Lambda^0}) \times P_{\Lambda^0}$ is also very small $\overline{\alpha P_\xi} = +0.01 \pm 0.11$. This implies that the Λ^0 was not, in most cases, directly produced in the interaction of a 1.3 (or 1.2)-Bev π^- with a nucleon of the carbon nucleus. Secondary strange particles are important in the depolarization process. The forward-backward asymmetry with respect to the Λ^0 laboratory line of flight was also measured. The result is compatible with zero when the effect of scanning bias is considered. From the analysis of the π^- stars from which a Λ^0 is emitted, information on the frequency of the Λ^0 production channels is derived. An upper limit is set to the cross-section for reaction $\Sigma^- + p \rightarrow \Lambda^0 + N$, $\sigma_{\Sigma^- \Lambda^0} \leq (38 \pm 24)$ mb. The lower limit to the frequency of secondary reactions is set to be 50%. (auth)

12359 ON THE DECAY $\Sigma^0 \rightarrow \Lambda^0 + \gamma$ IN THE CHARGE-INDEPENDENT PION INTERACTION. P. Prakash (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nuovo cimento (10), 22: 1293-6(Dec. 16, 1961). (In English)

The reactions $\Sigma^0 \rightarrow \pi^0 + \Sigma^+ + \gamma \rightarrow \Lambda^0 + \gamma$, $\Sigma^0 \rightarrow K^- + p + \gamma \rightarrow \Lambda^0 + \gamma$, and $\Sigma^0 \rightarrow K^+ + \Xi^- + \gamma \rightarrow \Lambda^0 + \gamma$ are analyzed. The anomalous magnetic moments are calculated and used in an analysis of the reaction $\Sigma^0 \rightarrow \Lambda^0 + e^+ + e^-$. Probability functions are derived. (L.N.N.)

12360 π^+ DECAY OF A $^4He_\Lambda$ HYPERFRAGMENT. Y. W. Kang, N. Kwak, J. Schneps, and P. A. Smith (Tufts Univ., Medford, Mass.). Nuovo cimento (10), 22: 1297-9(Dec. 16, 1961). (In English)

The decay reactions $_\Lambda He^4 \rightarrow n + \pi^+ + t$ and $_\Lambda He^4 \rightarrow n + n + \pi^+ + d$ are considered. $_\Lambda He^4$ hyperfragments were produced by 800-Mev/c K^- beams. Identification of decay products is described, and data are presented in graphical form. (L.N.N.)

12361 A NOTE ON NON-LINEAR EFFECTS IN ELECTRODYNAMICS. Z. Fried (U. S. Naval Ordnance Lab., Silver Spring, Md.). Nuovo cimento (10), 22: 1303-5 (Dec. 16, 1961). (In English)

Results on the reaction $\gamma + \gamma + e \rightarrow \gamma' + e'$, based on perturbative expansion of the S matrix in quantum electrodynamics, are presented. Kinematic features of the reactions $\gamma + \gamma + \gamma + e \rightarrow \gamma'' + e'$ and $e + \gamma + \gamma + \gamma \rightarrow \gamma' + \gamma + e$ are discussed. Anisotropic scattering media are not essential for these processes. (L.N.N.)

12362 A COUPLED ANALYSIS OF THE I = 3/2, J = 3/2, P AND D WAVES IN PION-NUCLEON SCATTERING. E. Galzenati and M. Pusterla (Università, Naples; Università, Bari, Italy; and Istituto Nazionale di Fisica Nucleare, Naples). Nuovo cimento (10), 22: 1306-9(Dec. 16, 1961). (In English)

The function $h_j^I(w) = (w/E + M)\,[f_{l+}^I(w)/K^{2l}]$, where E is the nucleon total energy in the cms, M is the nucleon mass, K is the cms momentum of the π-N system, J is $l + \frac{1}{2}$, and $f_{l+}^I(w)$ is the partial wave amplitude, is discussed. A phenomenological description of the dynamical singularities, particularly regarding short range forces, is presented. On the two physical cuts for $w < -M - 1$ and for $w > M + 1$, $h_j^I(w)$ is strictly related to the two partial wave amplitudes corresponding to different parity. Results can indicate an approximate behavior giving values in the two physical energy intervals where the waves are experimentally known and the elastic scattering is dominant. (L.N.N.)

12363 DIFFRACTION SCATTERING OF 1.6 GeV/c π^- ON p FOR SMALL MOMENTUM TRANSFER. J. Alitti, V. Alles-Borelli, J. P. Baton, et al (Laboratoire de Physique Corpusculaire à Haute Energie, Saclay, France). Nuovo cimento (10), 22: 1310-12(Dec. 16, 1961). (In English)

Absolute differential elastic cross sections of 1.6-Bev/c p-π^- interactions were measured using the Saclay 50-cm hydrogen chamber. The scan efficiency was about 97%. Data are presented in graphical form. (L.N.N.)

12364 PROTON ENERGY SPECTRA IN THE DRELL MODEL OF DOUBLE PHOTOPRODUCTION. C. Gualdi (Università, Rome). Nuovo cimento (10), 22: 1313-15 (Dec. 16, 1961). (In English)

The proton energy spectrum in the reaction $\gamma + p \rightarrow p + \pi^+ + \pi^-$ at 900 Mev is considered. Calculations using the Drell diagram are compared with data; both are presented in graphical form. The Drell-diagram cross sections are 10% of those obtained from data; no overlapping between π-π interactions and the Drell effect is possible. (L.N.N.)

12365 GAUGE INVARIANCE OF FORM FACTORS. P. Budini and T. Weber (Università, Trieste, Italy and Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nuovo cimento (10), 22: 1321-3(Dec. 16, 1961). (In English)

Discussions on validity limits of quantum electrodynamics usually are based on a comparison of data with theory into which form factors are introduced. The assumption that nonlocal-theory defects do not affect conclusions drawn is not valid when the form factors destroy the gauge invariance of the theory. Methods avoiding this difficulty are presented. (L.N.N.)

12366 THE "PHOTON-SPURION" AND DISPERSION THEORY. E. Leader (CERN, Geneva). Nuovo cimento (10), 22: 1324-5(Dec. 16, 1961). (In English)

It is shown that dispersion theory produces correct results in calculations of one-photon-exchange processes for physical, transverse photons. Existence of a third state of photon polarization at zero energy is unnecessary. (L.N.N.)

12367 SOME REMARKS ABOUT THE ISOVECTOR FORM FACTORS OF THE NUCLEONS AND THE ρ^0 MESON. G. Costa and A. H. Zimerman (CERN, Geneva). Nuovo cimento (10), 22: 1326-8(Dec. 16, 1961). (In English)

Consequences of the hypothesis of a narrow width for ρ^0 on the isovector form factors of nucleons are examined, and the ρ^0-N coupling is analyzed. Results on isovector form factors are based on subtracted dispersion relations in which only the two-pion resonance contribution is considered explicitly, in terms of the π electromagnetic form factor. (L.N.N.)

12368 THE EQUIVALENT TWO-BODY METHOD FOR THE HYPERTRITON. Leila Abou-Hadid and K. Higgins (University Coll., London). Proc. Phys. Soc. (London), 79: 34-41(Jan. 1, 1962).

The equivalent two-body method proposed by H. Feshbach and S. I. Rubinow (Phys. Rev. 98: 188(1955)) was applied to the calculation of the volume integral of the Λ-nucleon interaction necessary to explain the observed binding energy of the hypertriton. A smaller value of the volume integral is required than when a trial function of comparable simplicity is employed in the usual variation method. The effect of introducing a term in the potential representing a three-body Λ-nucleon-nucleon interaction is investigated. (auth)

12369 ESTIMATE OF A PARITY NON-CONSERVING CONTRIBUTION TO π^+-MESON PRODUCTION BY POLARIZED PROTONS. B. A. Presswood (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 79: 219-20(Jan. 1, 1962).

Results of parity nonconserving interactions of the first order in the weak coupling constant G are applied to p-N production of pions. These interactions are combined with strong pseudoscalar interactions to give a parity nonconserving term in the differential cross section. The calculation is performed in terms of general isotopic spin factors; results are evaluated explicity for π^+ production by polarized protons incident on nucleons. It is predicted that these parity nonconserving contributions to π^+ production are too small to be observed experimentally. (L.N.N.)

12370 CALCULATED ELECTRON MOBILITY IN NITROGEN, OXYGEN, AND AIR FOR $0.1 \leq E/p \leq 100$ v cm^{-1} $mmHg^{-1}$. A. E. D. Heylen (Univ. of London). Proc. Phys. Soc. (London), 79: 284-92(Feb. 1, 1962).

The influence of different electron energy distribution functions, whose mean energy is obtained from swarm experiment data, and of collision cross section variations upon the calculated mobility is investigated. It is shown that the mobility is mainly determined by the total scattering cross section and is insensitive to the form of the distribution, provided the cross section does not vary too rapidly with electron energy. Calculations are carried out assuming the Maxwellian distribution to hold and, using representations close to the experimental cross section data, agreement between calculated and experimental mobility is obtained for some of the available data. (auth)

12371 THE POLARIZATION IN FREE NEUTRON-PROTON SCATTERING AT 140 MEV. G. H. Stafford (Rutherford High Energy Lab., Harwell, Berks, Eng.) and C. Whitehead. Proc. Phys. Soc. (London), 79: 430-9 (Feb. 1, 1962).

Polarization in free n-p scattering at 140 ± 2 Mev was measured using the CERN synchrotron. The neutron energy spectrum was roughly triangular in shape with a base extending from 100 to 190 Mev. Asymmetries were measured using a solenoid to precess the neutrons. The neutron beam had a polarization of 0.226 ± 0.010 as determined by small-angle scattering from uranium and lead targets. Measurements of asymmetries in the scattering of the neutrons by liquid hydrogen targets were made at 14 center-of-mass angles between 20 and 160°, using multiple detectors and an electronic system that reduced systematic uncertainties normally present. Results agree with measurements using a different technique. Agreement is found with the phase shift sets YLAN3 and YLAN3M. (auth)

12372 RELATIVISTIC QUANTUM FIELD THEORY OF UNSTABLE PARTICLE. Mitsuru Hama and Sho Tanaka (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 26: 829-43 (Dec. 1961). (In English)

The relativistic theory of an unstable particle is formulated. The field operator of the unstable particle is expressed by the power series of the asymptotic field operator of its decay products with the coefficient of a-function. The recursion formula for a-function is given and solved in a simple model in comparison with one for the stable particle. Attention is given to the possibility of elimination of the field operator of the unstable particle from the framework of theory. (auth)

12373 ENERGY SPECTRUM AND DETERMINANT METHOD IN QUANTIZED FIELD THEORY. Shûkô Azuma (Fukusima Univ., Japan). Progr. Theoret. Phys. (Kyoto), 26: 861-78(Dec. 1961). (In English)

When multiple processes compete, a certain real combination of phase shifts has elementary properties. Levinson's theorem, which is generalized to field theory, is directly examined in a modified Lee model in which two channels compete. It is shown that the determinant quantity has an analytic property corresponding to the structure of the energy spectrum. A dispersion-like formula is obtained involving the stated phase shift, one by one for each eigenspace, which holds without any approximation on inelastic processes. An application of this property to a statistical-dynamical system is discussed. A relation on the asymptotic behavior of the phase shift is suggested, and a dif-

ference in whether a particle is elementary or composite is mentioned. (auth)

12374 ON THE QUATERNARY INTERMEDIATE BOSON IN THE WEAK INTERACTION. Yasuhisa Katayama (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 26: 879-99(Dec. 1961). (In English)

A hypothesis on the quaternary intermediate boson in the weak interaction is formulated using localization of transformations. Two transformations that belong to the generalized full symmetric group between proton, neutron, and Λ particle are utilized. One causes changes between the left-handed proton and the neutron, while the other does so between the left-handed neutron and the Λ particle. Three constituents of the quaternary boson are introduced to harmonize with the localization of the first transformation, and the remaining one is deduced from the localization of the other. The strongly interacting system is arranged to be invariant under the generalized full symmetric transformation so as to be unaffected by both transformations, while the weakly interacting system which is charge independent under the covariance of the first transformation becomes charge dependent after the second transformation. The first approximation of the resultant weak interaction is in harmony with $|\Delta I| = \frac{1}{2}$ law. The bare mass of the quaternary boson is small but finite in virtue of the coexistence of eleven mesons besides pions and kaons. The quaternary boson uniquely determines the conserved vector and axial-vector currents of the strongly interacting system, the violations of which are discussed by changing meson masses. (auth)

12375 SPIN AND STATISTICS. Lowell Brown (Harvard Univ., Cambridge, Mass.) and Julian Schwinger. Progr. Theoret. Phys. (Kyoto), 26: 917-26(Dec. 1961). (In English)

A general discussion of the vacuum expectation value for the product of two fields shows how the structure depends upon the integral or half-integral nature of the spin. When this is compared with the statement of statistics as the requirement that fields commute or anti-commute for points in space-like relation, at distances greater than any specified amount, the connection between spin and statistics follows. (auth)

12376 INTEGRAL REPRESENTATIONS FOR SCATTERING AMPLITUDES IN PERTURBATION THEORY. [PART] II. Noboru Nakanishi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 26: 927-41(Dec. 1961). (In English)

Precise supports of weight functions in the integral representation proposed previously are found for the equal-mass-particle, pion-pion, and nucleon-nucleon scatterings. The maximal momentum transfers below which dispersion relations are derived are improved. (auth)

12377 VISCOSITY OF FERMI PARTICLE SYSTEMS. Hisashi Nishimura (Kyushu Univ., Fukuoka) and Hazime Mori. Progr. Theoret. Phys. (Kyoto), 26: 967-89(Dec. 1961). (In English)

The quantum-statistical expression for the viscosity coefficient in terms of time correlation functions is calculated for Fermi gases, and an interpolation formula valid in the entire region of temperature is derived. The formula for the viscosity gives the temperature dependence of T^{-2} in the extremely degenerate case, and leads to Uehling's expression for the quantum correction in the slightly degenerate case, and to the Enskog-Chapman theory in the classical limit. The behavior in the intermediate temperature region between the extremely and slightly degenerate cases is determined with numerical calculation by using the S-wave approximation. It is shown that the minimum of the viscosity occurs at about 0.6 T_c, T_c being the degeneracy temperature. These results are used to discuss Zinov'eva's (J. Exptl. Theor. Phys., 34: 609(1958)) experiments on the viscosity of liquid He^3 by employing Landau's theory of Fermi liquid. The effective mass and the degeneracy temperature are determined from experiments on the heat capacity, as $m = 2.34\ m_3$ and $T_C = 2.13°K$ by assuming $a = 1.158 \times 10^{-8}$ cm for the scattering amplitude describing the collision between quasi-particles. (auth)

12378 ASSOCIATED PRODUCTION IN PION-NUCLEON COLLISIONS AND EFFECTS OF RESONANT STATES. Tetsuya Tsuchida (Hokkaido Univ., Sapporo), Tetsuro Sakuma, and Sinya Furui. Progr. Theoret. Phys. (Kyoto), 26: 1005-8(Dec. 1961). (In English)

Possibilities of explaining experimental features, angular distributions, polarization, and total cross sections in the reaction $\pi + p \rightarrow K^0 + \Lambda$ at 910 Mev by considering N^* (π-N third resonance), Y^* (π-Λ resonance), and K^* (K-π resonance) are investigated. Calculations are presented in graphical and tabular forms. (L.N.N.)

12379 ON THE INTERACTION OF THE PION AND CASCADE PARTICLE. Syurei Iwao (Syracuse Univ., N. Y.). Progr. Theoret. Phys. (Kyoto), 26: 1008-10(Dec. 1961). (In English)

The π-Ξ interaction is examined assuming that either direct coupling or derivative coupling is universal. The mass difference between the nucleon and the Ξ is included. Universality is assumed for the unrenormalized coupling constant and the cutoff energy in the static theory. The π-baryon is the strongest available. The reactions $K^- + p \rightarrow \Xi^{-*} + K^+ \rightarrow \Xi^- + \pi^0 + K^+$ and $K^- + p \rightarrow \Xi^{-*} + K^+ \rightarrow \Xi^0 + \pi^- + K^+$ are considered, and spin states are determined. Resonances for the states $(T,J) = (\frac{3}{2}, \frac{3}{2})$, $(\frac{3}{2}, \frac{5}{2})$, $(\frac{1}{2}, \frac{1}{2})$, and $(\frac{3}{2}, \frac{1}{2})$ with resonance energies roughly in the ratio 3:4:6 are expected. (L.N.N.)

12380 EFFECT OF PION-PION SCATTERING RESONANCE ON NUCLEON STRUCTURE. Atsushi Takahashi (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 26: 1012-14(Dec. 1961). (In English)

Effects of the π-π P-wave resonance on electromagnetic structure are investigated using a subtraction method. Thus, no cutoff procedure is necessary if the Legendre expansion is performed for the π-N scattering amplitudes over the left-hand cut (Frazer and Fulco, Phys. Rev., 117: 1603, 1609 (1960)). Values obtained are consistent with experimental data. (L.N.N.)

12381 PROOF OF PARTIAL-WAVE DISPERSION RELATIONS FOR PION-PION AND NUCLEON-NUCLEON SCATTERINGS IN PERTURBATION THEORY. Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 26: 1014-16(Dec. 1961). (In English)

Partial-wave dispersion relations for equal-mass-particle interactions, π-π and nucleon-nucleon, are proved in every order of perturbation theory. Results are identical with those derived from the Mandelstam representation (S. Mandelstam, Phys. Rev., 112: 1344(1958)). (L.N.N.)

12382 HYPOTHESIS OF THE ISOTOPIC SPIN INDEPENDENCE. [PART] II. Masaaki Kawaguchi (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 26: 1016-18 (Dec. 1961). (In English)

Criticism of the assumption that the S matrices are independent of total isotopic spin in the high-energy limit is offered by the process $\pi + N \rightarrow \pi + \pi + N$ in comparisons with results of peripheral interactions. Data are presented in graphical form. Similar arguments are offered for the reaction $N + N \rightarrow \pi + N + N$. (L.N.N.)

12383 THE ENERGY LOSS OF 1-MEV ELECTRONS IN VERY THIN LAYERS. G. Knop, A. Minten, and B. Nellen (Universität, Bonn). Z. Physik, 165: 533-53(1961). (In German)

Energy straggling of electrons passing through a thin layer of matter is no longer described by a Landau distribution if the thickness becomes smaller than a given value depending on the ionization energy of the electron shells. Systematic measurements of the energy loss of 1-Mev electrons in various materials were done using a magnetic spectrometer device which gave an energy resolution of 460 ev (and 1800 ev in case of thicker foils). The results confirm theoretical claculations of corrections due to shell effects and apparatus resolution except for foils below 3 mg/cm^2. (auth)

12384 THE POLARIZATION OF THE CHERENKOV RADIATION PRODUCED BY THE BETA RADIATION OF P^{32}. Friedrich Smend (Universität, Göttingen, Ger.). Z. Physik, 165: 554-61(1961). (In German)

The polarization of Cherenkov radiation produced in Plexiglas by the β rays of P^{32} was investigated by counting coincidences between fast electrons having traversed a thin Plexiglas plate and the light quanta emitted at an angle of 45° with respect to the track of the particles. The radiation was analyzed by a polarizing filter and was found to be linearly polarized, the degree of polarization being at least 87%. The remaining 13% of the observed intensity originate at least partly from weak scintillation which are excited by the β rays in Plexiglas and the intensity of which could not be measured exactly. With respect to this, the result is in agreement with the virtually complete linear polarization of Cherenkov radiation predicted by theory. (auth)

12385 g_j FACTORS OF THE ALKALI ATOMS Rb^{85}, Rb^{87}, AND Cs^{133} IN THE GROUND STATE. W. Wilke (Freie Universität, Berlin). Z. Physik, 165: 562-8(1961). (In German)

From measurements of magnetic dipole transitions between the Zeeman components of the hyperfine structure (hfs) doublets, the g_j factors of the atoms Rb^{85}, Rb^{87}, and Cs^{133} were measured in the ground state $^2S_{1/2}$. The transition frequencies lie at 9470 MHz and the magnetic fields between 1 and 5 kG. The observed absorption lines all have, at a vapor pressure of 0.07 mm Hg, the same line width of 0.45 G. The g_j factor of Cs^{133} is above the theoretical value, whereas the g_j factors of Rb^{85} and Rb^{87} agree well with the theoretical value, although they display a small difference. (tr-auth)

12386 DEPOLARIZATION OF μ^--MESONS IN THE FORMATION OF μ-MESIC ATOMS OF SPIN-$\frac{1}{2}$ NUCLEI. A. P. Bukhvostov and I. M. Shmushkevich (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1895-1906(Dec. 1961). (In Russian)

Besides a fine structure, the levels of μ mesic atoms produced on non-zero-spin nuclei also have a hyperfine structure. If the hyperfine splitting of weakly excited levels is large compared to their width, this splitting should be important for the magnitude of μ^- meson depolarization. The magnitude of the effect is estimated for the case when the nuclear spin is $\frac{1}{2}$. If the hyperfine splitting of the lower excited levels is large compared to their width, the polarization of a μ meson in the K shell should be approximately $\frac{1}{3}$ of that for a nuclear spin of zero. Conversely, if the level width considerably exceeds the hyperfine splitting the hyperfine structure will only be manifest in the K shell and the polarization will decrease to $\frac{1}{2}$ that of a zero-spin nucleus. (auth)

12387 DISPERSION REPRESENTATION OF THE DEUTERON FORM FACTOR. V. V. Anisovich (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1907-14(Dec. 1961). (In Russian)

The second anomalous singularity of the deuteron form factor, at $s \sim 9\ \mu^2$, is considered. The dispersion representation for the simplest graph that yields this singularity is presented. A method is developed that simplifies calculations of the absorption parts of the diagrams with three free ends. (auth)

12388 ON HEAVY NEUTRAL PSEUDOSCALAR MESONS. I. Yu. Kobzarev and L. B. Okun. Zhur. Eksptl'. i Teoret. Fiz., 41: 1949-52(Dec. 1961). (In Russian)

Arguments in favor of the existence of heavy neutral pseudoscalar mesons with zero isotopic spin are discussed. Some experiments that should help to ascertain whether these mesons exist are suggested. (auth)

12389 ON A CERTAIN POSSIBILITY OF DETECTING HIGH-ENERGY CHARGED PARTICLES. A. I. Alikhanyan, F. R. Arutyunyan, K. A. Ispiryan, and M. L. Ter-Mikaelyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 2002-10(Dec. 1961). (In Russian)

The characteristic properties of the radiation emitted by charged particles moving in lamellar media are investigated. The possibilities of detecting such radiation are discussed and some methods are suggested for this purpose. Methods of employing the radiation for detecting charged particles and measuring their energy are also considered. (auth)

12390 ON PHOTODISINTEGRATION OF THE DEUTERON AT MEDIUM ENERGIES. L. N. Shtarkov (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 2011-14(Dec. 1961). (In Russian)

An analysis is made of experimental data on photodisintegration of the deuteron. Results are obtained for four angular distribution parameters at six values of the mean γ energy between 50 and 150 Mev. The results are compared with theoretical calculations. In the greater part of the investigated energy region agreement is found, and at the highest energies the experimental values are found to slightly exceed the theoretical ones. Some conclusions concerning the theory of photodisintegration of the deuteron are drawn and some possible reasons why the theoretical values are smaller are discussed. It is explained why precise experiments on photodisintegration of the deuteron at energies below the meson production threshold should be carried out. (auth)

12391 HIGH-ENERGY π-MESON SCATTERING AT LARGE ANGLES. Yu. D. Bayukov, G. A. Leksin, and Ya. Ya. Shalamov. Zhur. Eksptl'. i Teoret. Fiz., 41: 2016-18(Dec. 1961). (In Russian)

Scattering of high-energy π mesons at near 180° angle in a center-of-mass system in (1) $\pi^- + p \rightarrow \pi^0 + n$ exchange and (2) $\pi^+ + p \rightarrow \pi^+ + p$ elastic scattering was studied previously at 2.8 Bev using a bubble chamber filled with propane–xenon mixture. The angular distribution of γ quanta in a πN center-of-mass system was analyzed without considering the recording efficiency in the chamber. Graphs are plotted for the cases of 3 to 6 electron-positron pairs directed into the π-meson vanishing point, two pairs, and one conversion pair. The mean recording efficiency for γ quanta (~0.52) permits the separation of reaction (1) from the reaction producing several π mesons. The elastic recharge with π^--meson emission was not observed while one case on the graph is related to the π^0-

meson production or to the π^0-meson emission in the reaction (1) beyond an angle of 1 steradian around 180°. The upper cross section limit is $\sigma < 0.01$ mb/sterad. The cross section of elastic recharge emitting π^0 meson at an angle exceeding 90° center-of-mass system is $\lesssim 0.002$ mb/sterad. Identical data are obtained with bubble chambers filled with freon. (R.V.J.)

12392 ANALYSIS OF 9 BEV PROTON-NUCLEON INTERACTIONS IN A NUCLEAR EMULSION. E. G. Boos, V. A. Botvin, N. P. Pavlova, Zh. S. Takibaev, and I. Ya. Chasnikov (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 3-11 (Jan. 1962). (In Russian)

The dependence of the angular and energy characteristics of proton–nucleon interactions on the observed multiplicity is investigated. An approximate method is developed with the assumption that the transverse momentum distribution is constant. (auth)

12393 INVARIANT PARAMETRIZATION OF THE RELATIVISTIC SCATTERING MATRIX. A. A. Cheshkov and Yu. M. Shirokov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 144-51 (Jan. 1962). (In Russian)

Invariant parametrization of the relativistic amplitude for scattering through given angles is carried out for reactions with arbitrary particle spins. The analysis is applicable to zero as well as non-zero rest mass particles. (auth)

12394 GRAVITATIONAL RADIATION BY A RELATIVISTIC PARTICLE. V. I. Pustovoit and M. E. Gertsenshtein (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 163-70 (Jan. 1962). (In Russian)

Gravitational radiation from a charged relativistic particle moving in a magnetic field was calculated. Not only is the mass tensor of the particle itself a source of the gravitational waves but also those electromagnetic stresses caused by the charge, their contribution being of the same order as that of the mass. The small additions to the metric tensor correspond to two processes of gravitational wave formation: to the usual type of charge and mass emission and to resonance emission of gravitational waves by the electromagnetic field in the presence of a constant external magnetic field. The latter effect was considered before. It is shown that the energy dependence of gravitational wave intensity in the ultrarelativistic case is the same as that of an electromagnetic field. (auth)

12395 ESTIMATES OF THE EFFECTIVE PARTICLE INTERACTION RADIUS. M. I. Shirokov. Zhur. Eksptl'. i Teoret. Fiz., 42: 173-7 (Jan. 1962). (In Russian)

Effective strong interaction radii are discussed considering the number of the last term of the angular distribution expansion in Legendre polynomials, the known value of the total channel cross section and the value of the angular distribution as a given point, the total cross sections of all channels and the elastic scattering channel cross sections, and the mean square of transversal momentum with the aid of the uncertainty relation. The first two methods are extended to the case of inelastic reactions of the most general form $a + b \to c + d + e + \ldots$ (the particle spins being arbitrary). None of the methods are related to any particular interaction model (potential wall, optical model). (auth)

12396 POLARIZATION AND CHARGE EXCHANGE INTERACTION IN THE HIGH ENERGY πp SCATTERING. I. I. Levintov (Inst. of Theoretical and Experimental Physics, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 191-5 (Jan. 1962). (In Russian)

If the charge exchange cross section in π-p scattering approaches $\sigma_n(\Delta^2, \infty) \neq 0$ for $E \to \infty$, then the limiting value of the polarization will be $|P_\infty| < [\sigma_n(\Delta^2, \infty)/\sigma(\Delta^2, \infty)]^{1/2}$, $\sigma(\Delta^2, \infty)$ is the limiting cross section for elastic π-p scattering into a unit interval of the squared transferred momentum. The limiting polarization should be equal but opposite in sign in π^+ and π^- scattering. If $\sigma_n(\Delta^2, \infty) = 0$, then $P_\infty = 0$ also. (auth)

12397 ANALYTIC CONTINUATION OF THE THREE-PARTICLE UNITARITY CONDITION. SIMPLEST DIAGRAMS. V. N. Gribov and I. T. Dyatlov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 42: 196-210 (Jan. 1962). (In Russian)

The three-particle unitarity condition for the simplest class of diagrams is analytically continued with respect to the transferred momentum t. It is an analytical function of t which possesses singularities only on the real axis. This is consistent with the Mandelstam representation. The spectral function $\rho(s, t)$ is represented as a Feynman integral in which the denominators are replaced by δ-functions. Integration with respect to variables not defined by δ-functions is carried out in the complex region. The form of this region for the given class of diagrams is determined. (auth)

12398 INELASTIC HIGH ENERGY PION-NUCLEON INTERACTIONS. V. S. Barashenkov, D. I. Blokhintsev, Jung Wang, E. K. Mihul, Tsu-chan Huang, and Shu-k'o Hu (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 217-22 (Jan. 1962). (In Russian)

Peripheral interaction between π mesons and nucleons is considered in the single meson approximation. Comparison of calculated values of the multiplicity of the created particle and the angular and energy distributions of the recoil nucleon and of its transverse momentum with the experimental values indicate that at high energies π-N collisions due to π-π interaction are predominant. (auth)

12399 CONTRIBUTION TO THE THEORY OF THE $\pi + N \to N + \pi + \pi$ AND $\gamma + N \to N + \pi + \pi$ REACTIONS NEAR THE THRESHOLD. V. A. Anisovich, A. A. Ansel'm, and V. N. Gribov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 42: 224-35 (Jan. 1962). (In Russian)

Amplitudes and cross sections for the reactions are considered with an accuracy to quadratic terms in threshold momenta. The dependence of cross sections on kinetic energy of the particles produced is expressed in an explicit form. In principle from an analysis of the experimental data of the reactions it is possible to determine both π-π interaction amplitudes, a_0 and a_2, at zero energy and in isotopic spin states $T = 0$ and $T = 2$. This may be compared with the analysis carried out with an accuracy to linear terms in the momenta, which yields only the charge exchange amplitude $a_2 - a_0$. In the first part of the paper a convenient dispersion method was presented for calculating diagrams which are important in the problem. (auth)

12400 NEUTRAL BARYON CURRENTS AND SINGLE PRODUCTION OF HYPERONS. M. A. Markov and Nguyen Van-hieu (Joint Inst. of Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 273-4 (Jan. 1962). (In Russian)

The $n + n \to \Lambda + n$ process is regarded as the result of a weak interaction. A search was made for experiments which could be performed to decide whether or not neutral currents are absent in the weak interaction Lagrangian. (auth)

12401 DIRECT TRANSMISSION OF THE HIGH-FREQUENCY ELECTROMAGNETIC FIELD ENERGY INTO MECHANICAL WORK. R. A. Valitov, V. D. Kukush, and V. G. Orlov (Khar'kov State Univ.). Zhur. Tekh. Fiz., 31: 1462-6(Dec. 1961). (In Russian)

Continuous direct conversion of high-frequency electromagnetic energy into mechanical work was achieved. The efficiency coefficient is very low ($\sim 10^{-9}$%) due to large energy losses at the walls of a spherical waveguide. The efficiency can be increased by utilizing slowing down systems. (R.V.J.)

12402 REFLECTION OF ELECTROMAGNETIC WAVES FROM MOVING SURFACES. A. M. Kovalev and V. N. Krasil'nikov (Leningrad State Univ.). Zhur. Tekh. Fiz., 32: 30-2(Jan. 1962). (In Russian)

The reflection of a plane electromagnetic wave from a moving ideally conducting plane (mirror) is studied for cases in which incidence is normal to a mirror moving according to an arbitrary law and in which incidence is inclined to a mirror in a reciprocal, periodic-law motion. An equation was derived for describing electromagnetic energy in the presence of ideal conductors in motion. (R.V.J.)

Neutron Physics

12403 (EANDC (E) 14) EFFECTIVE CROSS SECTIONS FOR THERMAL REACTORS, OAK RIDGE MEETING, NOVEMBER 14, 1960. J. Horowitz and O. Tretiakoff (European–American Nuclear Data Committee). 46p.

The "effective cross section" characterization of a thermal reactor utilizes two parameters, viz. the "joining function" and the "neutron temperature." In order to extend the applicability of this characterization to lattices in which two parameters are insufficient, a method is found to describe the neutron distribution in terms of a number of additional parameters, each of which is directly related to some physical property of the lattice. Results are found for infinite homogeneous and heterogeneous lattices. Numerical calculations are presented for a particular neutron model—heavy gas, 1/v absorption, and one heterogeneity parameter deduced from the fundamental spatial mode. (T.F.H.)

12404 (NP-11332) THE MULTIGROUP METHOD AS USED BY THE PRATT AND WHITNEY PHYSICS GROUP. F. C. Merriman (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Sept. 19, 1955. 10p. (TIM-204)

A description is given of the development of the multigroup method as used on the IBM-701 digital computer. The theory of the method is based on that written by Ehrlick and Hurwitz. In this development, the age-diffusion equation is expressed in terms of the flux rather than the slowing down density. The inelastic scattering contribution to the source term has been retained in the numerical solution of the second-order differential equation. The equations developed using this method are very convenient for calculations using the IBM-701. (auth)

12405 ESCAPE PROBABILITIES AND ITS APPLICATION TO THE CALCULATION OF THE DANCOFF COEFFICIENT IN THE RESONANCE INTEGRAL. G. Velarde (Junta de Energia Nuclear, Madrid). Energia nuclear (Madrid), 5: 24-47(July-Sept. 1961). (In Spanish)

A precise calculation of the escape probability of a neutron is of importance in the calculation of the multiplication factor of a reactor. A review is made of the development of the calculation of escape probabilities. These probabilities were first calculated for plates, bars, spheres, ellipsoids, and rods with vacant cores. The relationship between the effective surface and the real surface of the resonance integral was calculated and the Dancoff coefficient, the escape probability coefficient, was introduced. It was applied to the case of parallel cylindrical bars. A formula was derived which was difficult to evaluate numerically, and it was then simplified. Previous calculations were repeated using a simpler expression with the function Ki_3. An approximate formula for the case of various parallel cylindrical bars was then derived. (J.S.R.)

12406 NEUTRONS FROM Po–Be SOURCES. S. Notarrigo, R. Parisi, R. Ricamo, and A. Rubbino (Università, Sezione Siciliana dell' INFN and Centro Siciliano di Fisica Nucleare, Catania, Italy). Nuclear Phys., 29: 507-14(Jan. 1962). (In English)

Because of discrepancies, the neutron energy spectrum from a Po–Be source is once more studied using photoplates. Experimental results agree with the calculated spectrum and with other measurements. (auth)

12407 MEASUREMENT OF NEUTRON DIFFUSION PARAMETERS IN WATER BY THE PULSED NEUTRON METHOD. W. M. Lopez and J. R. Beyster (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nuclear Sci. and Eng., 12: 190-202(Feb. 1962). (GA-1584(Rev.))

Neutron diffusion parameters in water were measured at 26.7°C with the pulsed neutron technique. The results are 210 ± 1 μsec for the neutron mean lifetime, 37503 ± 366 $cm^2\ sec^{-1}$ for the average diffusion coefficient, and 5116 ± 776 $cm^4\ sec^{-1}$ for the diffusion cooling constant. From these values the thermal absorption cross section of hydrogen and the thermal diffusion length in water can be inferred to be 325 ± 2 mb and 2.83 ± 0.02 cm, respectively. With a pulsed high-intensity neutron source provided by an electron linear accelerator, neutron lifetime measurements were performed on small and large water samples with values of the geometrical buckling from 0.014 cm^{-2} to 0.59 cm^{-2}. Effects of harmonic modes in the large water geometries, which were determined by measurements of the time-dependent spatial flux distributions resulting from an external pulsed source of fast neutrons, were found to be adequately predictable with simple diffusion theory. (auth)

12408 NEUTRON DIFFUSION IN A TEMPERATURE GRADIENT. J. R. L. de Ladonchamps and L. M. Grossman (Univ. of California, Berkeley). Nuclear Sci. and Eng., 12: 238-42(Feb. 1962).

The space energy distribution of neutrons diffusing in a source-free, nonabsorbing medium possessing a temperature gradient is obtained by solving the appropriate Boltzmann equation to a second order approximation using the expansion technique of Chapman and Enskog. The medium is assumed to possess a locally Maxwellian energy distribution and the neutron scattering is taken to be isotropic in the laboratory system of coordinates. It is found that the neutron current is increased in the direction of a negative temperature gradient and the thermal diffusion transport coefficient is evaluated as a function of the mass of the moderator nuclei. For the case of infinite mass nuclei, the results correspond to the kinetic theory model of a Knudsen gas in a binary Lorentzian gas mixture. An analysis of the results is carried out in the framework of the thermodynamic theory of coupled irreversible processes. (auth)

12409 THE SCATTERING OF THERMAL NEUTRONS BY MODERATORS. P. A. Egelstaff (Atomic Energy Re-

search Establishment, Harwell, Berks, Eng.). Nuclear Sci. and Eng., 12: 250-9(Feb. 1962).

A comprehensive scheme for the analysis and use of thermal neutron scattering data is described. Experimental work was carried out with a 4-rotor high speed chopper system operated in conjunction with a multicounter multichannel neutron time-of-flight system. The results are reduced to a scattering law, which is a function S of two variables (α and β) representing the momentum and energy transferred in the scattering process. The scattering law can be divided into interference and self-terms; for the application to neutron spectrum calculations it is sufficient to consider the interference term as a small correction to the self-term. The self-term is the double Fourier transformation of the self-correlation function of Van Hove, which represents the motion of an individual atom in the system. This function can be represented as a gaussian distribution of the atomic position plus correction terms. The width of this gaussian distribution is a function of time and its double differential with respect to time is the velocity correlation function for an atom in the system. Thus the velocity correlation function is the function which makes the major contribution to the scattering cross sections. In estimating the accuracy to which measurements, analysis, and calculations of the scattering law need be made, it is necessary to evaluate a sensitivity function for each neutron spectrum problem, and thus for each scattering law a variety of sensitivity functions need to be evaluated. Two simple examples are discussed which show, separately, the effect of absorption and temperature gradients. (auth)

12410 ON THE EVALUATION OF THE THERMAL NEUTRON SCATTERING LAW. P. A. Egelstaff and P. Schofield (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Sci. and Eng., 12: 260-70(Feb. 1962).

The magnitude of the scattering cross section for slow neutrons by atomic systems (gases, liquids, and polycrystalline solids) is governed by the correlated motions of atoms in the system. A major contribution to the scattering is determined by the motion of single atoms. The dominant part of this contribution is determined by the velocity autocorrelation function for an atom in the system. The aim here is to show how the autocorrelation function can be derived from experimental scattering data for small momentum transfers and to give methods of evaluation of the corresponding part of the cross section for all momentum and energy transfers in terms of the experimentally observed quantities. The methods are chosen to minimize computational difficulties and inaccuracies. The comparison of the recomputed data with the experimental results permits the estimate of other contributions to the scattering. Some simple examples of these methods are given, and the relevance of this work to thermal neutron transport calculations is mentioned. (auth)

12411 TRANSPORT MEAN FREE PATH AND DIFFUSION LENGTH OF NEUTRONS CALCULATED FROM MARKOV CHAIN STATISTICS. E. Richard Cohen (Atomics International, Canoga Park, Calif.). Nuclear Sci. and Eng., 12: 309-10(Feb. 1962).

A derivation is given of the transport mean free path and the diffusion length in a homogeneous medium. The derivation is more concise than the random walk method and gives additional physical insight into the concepts of the random walk mechanism. The diffusion length is exact for all absorption ratios and for any scattering law. The diffusion length is not equal to the asymptotic diffusion length, except in the usual limit of small absorption; the mean square distance to absorption is $6L^2$. (N.W.R.)

12412 SLOWING DOWN WITH ANISOTROPIC SCATTERING. A. Keane and J. P. Pollard (Australian Atomic Energy Commission, Sutherland, N.S.W., Australia). Nuclear Sci. and Eng., 12: 313-14(Feb. 1962).

The technique of expanding Laplace transforms in a series of the transform variable before inversion was applied earlier to determine the flux obtained from an energy distributed neutron source in an infinite homogeneous system. This method is extended to slowing down when the differential scattering cross section of the nuclei is anisotropic in the center-of-mass system. It is assumed that the angular distribution of scattered neutrons is independent of the initial energy and will also omit extraneous complications, such as absorption, in order to give a simple outline of the main feature of the problem. (N.W.R.)

12413 MULTICHANNEL FLUX SYNTHESIS. E. L. Wachspress, R. D. Burgess, and S. Baron (Knolls Atomic Power Lab., Schenectady, N. Y.). Nuclear Sci. and Eng., 12: 381-9(Mar. 1962).

A procedure is described for calculating neutron fluxes at nodes of a three dimensional grid with few points, in planes perpendicular to a selected axis. Difference equations relating fluxes within each plane are determined in advance from detailed two-dimensional studies. This "multichannel synthesis" model may be used for parameter studies and dynamic analysis. Comparison of a representative calculation with results of a detailed three-dimensional computation is given. (auth)

12414 SPATIAL DEPENDENCE OF THERMAL-NEUTRON SPECTRA AND THE INTERPRETATION OF THERMAL UTILIZATION MEASUREMENTS. R. Sher (Brookhaven National Lab., Upton, N. Y.), H. Kouts, and D. Klein. Nuclear Sci. and Eng., 12: 432-3(Mar. 1962).

Experimental determinations of the thermal utilization factor (f) are discussed, and effects on f of neutron temperature differences between fuel and moderator are considered. It is noted that even though the Maxwellian temperature difference may be as high as 200°, consideration of the slowing-down component of the spectrum and of the poor thermalization of the neutrons invalidates the Maxwellian calculation. The error in f caused by neglect of the temperature difference is concluded to be negligible. (T.F.H.)

12415 MEASURED SLOWING DOWN DISTRIBUTION AT THE INDIUM RESONANCE FROM A LINE SOURCE OF FISSION NEUTRONS IN HEAVY WATER. W. E. Graves (E. I. du Pont de Nemours & Co., Aiken, S. C.). Nuclear Sci. and Eng., 12: 439-41(Mar. 1962).

The neutron slowing-down distribution and age at In resonance from a line U source in heavy water are measured. The measured values are compared with values calculated from point-source data. The age at In resonance is obtained as 111 cm^2. (T.F.H.)

12416 NEUTRON DIFFUSION IN SMALL VOLUMES OF WATER: PULSED SOURCE MEASUREMENTS. R. S. Hall, S. A. Scott, and J. Walker (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 79: 257-63(Feb. 1, 1962).

Thermal neutron diffusion parameters for light water were measured using the pulsed neutron source technique. It was demonstrated that the value of the diffusion cooling coefficient is critically dependent on the physical shape of the experimental system. Experimental results were analyzed using two different values of the extrapolation length, since the value of this parameter is not accurately known. Discrepancies between values of the diffusion parameters are explained by their dependence on system shape and extrapolation length. (auth)

12417 THE WEIGHTING OF DIFFUSION COEFFICIENTS IN CELL CALCULATIONS. D. C. Leslie (Atomic Energy Establishment, Winfrith, Eng.). Reactor Sci. and Technol., J. Nuclear Energy, Pts. A & B, 16: 1-11(Jan. 1962).

A new theory of leakage in heterogeneous systems is based on Benoist's lemma that the leakage from a region of such a system is equal to B^2L^2, B^2 being the geometric buckling and L^2 one-sixth of the mean square distance travelled by a neutron between birth and death, provided B^2 is small. L^2 is calculated exactly and directly and is shown to depend on a new type of flux ξ arising from a tilted source: this flux can be calculated in one lattice cell, so that it is no longer necessary to consider migration over the lattice as a whole to compute leakage. The exact calculation of ξ is troublesome, but a diffusion theory calculation can be carried through quite easily. From this, it appears that the radial and axial migration areas are given by $L_r^2 = \overline{D}_r/\overline{\Sigma}_a$ and $L_z^2 = \overline{D}_z/\overline{\Sigma}_a$, $\overline{\Sigma}_a$ being the normal cell-averaged absorption cross section. $\overline{D}_z$ is obtained by weighting the local diffusion coefficient with the usual flux, and $\overline{D}_r$ by weighting with a new flux derived from ξ. There is thus a migration area asymmetry even in the absence of holes, and an example suggests that in some lattices this asymmetry may be quite substantial. The theory may also be applied to more conventional streaming problems, and this application is discussed. (auth)

Nuclear Properties and Reactions

Refer also to abstracts 11690, 11691, 11692, 11693, 11694, 11695, 11696, and 11697.

12418 (AD-262135) NEUTRON YIELD FROM THE N^{15}(d,n) REACTION (thesis). Gail Lamar Legate (Texas. Univ., Austin). Aug. 1961. 41p.

A N^{15} gas target was bombarded with deuterons from a 2-Mev Van de Graaff accelerator, and the neutron yield from the (d,n) reaction was measured by the time-of-flight method. Angular distributions for each of three neutron energy ranges (1 to 3, 3 to 7, and >7 Mev) were obtained at a bombarding energy of 1.25 Mev. An excitation curve was obtained for the ground state neutrons in the 0.95 to 1.35 Mev range, and differential cross sections for each group were calculated for a bombarding energy of 1.25 Mev. (D.L.C.)

12419 (ANL-5567(Rev.)) NEUTRON SCATTERING ANGULAR DISTRIBUTION. A. Langsdorf, Jr., R. O. Lane, and J. E. Monahan (Argonne National Lab., Ill.). Oct. 1961. Contract W-31-109-eng-38. 189p.

The 41 graphs present the results of a survey of the angular distribution of neutrons scattered from 36 elements, two compounds, and one alloy. The data are presented in the form of an expansion in a series of Legendre polynomials, $\sigma(\theta) = (\sigma_t/4\pi)\ \Sigma_{l=0}^{4}\ \omega_l\ P_l(\cos\theta)$, in the laboratory coordinate system. The graphs give σ_t, ω_1, ω_2, ω_3, and ω_4 as a function of neutron energy. Since the detector system used BF_3 proportional counters immersed in an oil moderator so arranged as to have constant (within 10%) counting efficiency for neutrons of all energies from 100 kev to 1500 kev, $\sigma(\theta)$ is the total differential scattering cross section. The actual scattering detectors were positioned at five scattering angles: 22°, 54°, 92° (on the transmission side of the plate scatterer), 112°, and 144° (on the reflection side). Therefore $\sigma(\theta)$, as given by the above expansion, will be correct at these angles even if the value thus extrapolated to other angles is slightly erroneous. The angular distribution was measured usually at about 80-kev intervals for each element; the resolution was ~100 kev at the lower energies, decreasing to ~60 kev at the higher incident energies. For the transmission angles the angular resolution was ~5°, while for the reflection angles it was ~3°. A statistical analysis of part of the data, as well as an observation of the general consistency, indicated standard deviations of ~±0.05 for ω_1 and ±0.10 for ω_4, with the accuracy of ω_2 and ω_3 being intermediate between these values. These deviations are roughly independent of the values of the ω_l. In most cases the total cross section, σ_t, is probably accurate to better than 10% statistically. It was necessary to "can" some eight materials in containers of 0.005-in. shim stock steel. For these samples the background counting rates, measured with an empty can in place of the scatterer, were higher than in other cases, leading to slightly less accurate results statistically and also to slightly larger systematic errors. All total cross sections are evaluated in terms of the total cross section of a given sample of carbon, the value of which was taken from BNL-325 and unpublished data. In several graphs data are given for two or more thicknesses of scattering sample at the same neutron energy. In some of these cases ($_6$C, $_{11}$Na, $_{12}$Mg, $_{47}$Ag, and $_{92}$U) several thicknesses were corrected for plural scattering. The experiment and the analytical methods which were used to obtain corrected cross sections in the representation shown in the graphs are described. The analytical methods of obtaining a microscopic differential cross section from the raw data are described. A discussion of the plural scattering corrections for this geometry (a collimated beam of particles incident on a thin flat scatterer) is presented. Some modifications, both in experimental procedure and analytical treatment of the data, which are planned for future experiments of this type are discussed. (auth)

12420 (APEX-515) CROSS SECTIONS FOR REACTOR ANALYSIS. W. B. Henderson and Mary J. Stanley (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 1957. Contracts AF 33(600)-38062 and AT(11-1)-17. 243p.

A reproduction of the nuclear data contained on IBM 704 magnetic tape is presented. Cross sections, for the most part, were reproduced here from Multilith masters made by listing the tape directly on Multilith paper in the IBM 704 printer. This procedure insures that the cross sections presented here are a true reproduction of the data on tape and that the data are free of typographical errors. Other nuclear data (spectra, energy, and summary of thermal cross sections) were transcribed from the tape listing and are presented in a more compact and more easily identified format than is found on the tape listing. (auth)

12421 (ARF-1164-15) RESEARCH ON NEUTRON INTERACTIONS IN MATTER AS RELATED TO IMAGE FORMATION. Annual Report. H. V. Watts (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Oct. 12, 1961. Contract AT(11-1)-578. 83p.

Research designed to optimize the characteristics (sensitivity and resolution) of a neutron imaging detector system to be compatible with the neutron image quality is described. The characteristics of various neutron image detectors such as, activation foils with x-ray film, neutron sensitive phosphor screens with film, bundles of rods of neutron scintillators, multiwire spark chambers, arrays of small semiconductor detectors, and optical image intensifiers or readout tubes in conjunction with the luminescent materials were considered. In considering the applications of neutron imaging it was concluded that most neutron imaging will be performed with thermal neutrons where the

cross section differences among elements vary appreciably, but where scattering constitutes a major part of the total cross section for many elements. The effect of scattering upon the image quality is shown to be appreciable in certain instances. Two illustrative examples of the contrast differences between thermal neutron radiography and x-ray radiography are shown. Examples of inspection applications for neutron radiography include such items as reactor control rods, plastic or rubber tubing components in air frames, cadmium plating, and low atomic number elements in the presence of high atomic number elements. An optical technique which simulates the neutron intensity pattern at the image plane for a radiographic object containing both neutron absorption and neutron scattering was developed. This technique allows production, with a simple optical bench apparatus, of a simulated image which includes the effects of both the imaging detector resolution and the neutron scattering in the object. Optically synthesized images compare favorably with analogous neutron radiographs. The optical analog for neutron radiography is now being used to perform a parameter study of the image degradation due to detector resolution, without the costs of fabricating new neutron imaging detector systems at this time. It was concluded that there exist, discharge tube or accelerator type neutron sources with neutron intensities sufficient to obtain neutron radiographs with existing detection techniques in reasonable exposure times. The future use of isotopic neutron sources for neutron radiography appears promising, by virtue of improved neutron image detectors and/or higher yield isotopic neutron sources. It was concluded that neutron imaging or radiography represents an invaluable complement to x-ray and gamma-ray radiography for many applications. (auth)

12422 (INSJ-44) NUMERICAL DIFFERENTIAL CROSS SECTIONS OF ELASTIC SCATTERINGS OF DEUTERONS FROM Be, C, Mg, Ni AND Au AT ENERGIES FROM 15 TO 18 MEV. Yoshihide Ishizaki, Yoshio Saji, Toshiyuki Ishimatsu, Teruo Nakamura, Yoshihiro Nakano, and Shinjiro Yasumi (Tokyo Univ. Inst. for Nuclear Study). Dec. 5, 1961. 6p.

Differential cross sections were measured for the elastic scattering of deuterons at 14.7 to 18.1 Mev from beryllium, carbon, magnesium, and gold foils and from enriched Ni^{60} targets. Tabulations are included of the numerical results. (B.O.G.)

12423 (IA-645) CALCULATION OF SPECIFIC ACTIVITY OF ISOTOPES PRODUCED BY INTERMITTENT IRRADIATION. J. Flegenheimer (Argentina. Comision Nacional de Energia Atomica, Buenos, Aires), M. Givon and Y. Marcus (Israel. Atomic Energy Commission, Tel-Aviv). Dec. 1961. 10p.

A graphical method for the estimation of the specific activity of isotopes produced by intermittent irradiation at constant neutron flux is described. An extension of the method is applicable to the case where the flux varies from one irradiation period to the other. (auth)

12424 (CRRP-985C) EXPERIMENTAL EFFECTIVE FISSION CROSS SECTIONS AND NEUTRON SPECTRA IN A URANIUM FUEL ROD. PART III. CANDU-TYPE FUEL WITH H_2O-D_2O MIXTURES AS COOLANTS. B. G. Chidley, R. B. Turner, and C. B. Bigham (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 1961. 97p. (AECL-1419)

The neutron spectrum parameters in a CANDU-type fuel cluster, with several light and heavy water mixtures as coolants, were determined from relative reaction rates. This is an extension of the measurements for heavy water coolant reported in CRRP-985-B. The dependence of neutron temperature T and epi-thermal index $r\sqrt{T/T_0}$ on light water concentration up to 100% and on coolant temperature up to 280°C are given. (auth)

12425 (CERN-62-6) π^--p COLLISIONS AROUND 3 GeV (LAB.) TREATED BY A STATISTICAL THEORY. J. Soln (European Organization for Nuclear Research, Geneva). Jan. 26, 1962. 37p.

In this paper π^--paper collisions at several primary energies were investigated by means of the statistical theory. Emphasis was given to the excited states of the K-mesons and hyperons and their kinematical consequences (peaks in the spectra). The spectra, the branching ratios between final states, and average multiplicities of particles are given in the form of tables and graphs. (auth)

12426 (BAW-158) 40-GROUP NEUTRON CROSS SECTION LIBRARY FOR THE BPG AND SPECTRAL "B" COMPUTER CODES. K. E. Roach and W. A. Wittkopf (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). June 1961. 39p.

Six types of nuclear cross sections are averaged for a forty-energy-group scheme for twenty-eight different isotopes and elements. In addition, five distribution functions for absorption in fertile materials are computed for these groups. The group scheme represents a compromise between the number of groups required at high energy to represent important leakage and the number required to represent resonance neutron capture. (auth)

12427 (JINR-D-832) ON THE EXTRAPOLATION OF THE EXPERIMENTAL SCATTERING AMPLITUDE TO THE SPECTRAL FUNCTION REGION. I. Ciulli, S. Ciulli, and J. Fischer (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 7p.

The properties of the conformal mapping approach in various problems connected with the analytical properties of the scattering amplitude are pointed out. The convergence on the cut was studied without appealing to the properties of the amplitude on the nonphysical Riemann sheets, but using the fact that the spectral function has no singularities worse than $1/\sqrt{t_1-t}$. (M.C.G.)

12428 (JINR-D-856) PION PRODUCTION AT LOW ENERGIES. Kim Tse Peng and W. Zoellner (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 12p.

The cross sections for the reactions $\pi^4 + p \rightarrow 2\pi + N$ are determined by means of static integral equations which satisfy the properties of crossing symmetry. It is possible to explain the increase of the cross section of the reaction $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ at low energies without explicit consideration of the π-π interaction. Available data for other reactions are discussed. (auth)

12429 (JINR-P-841) O DINAMICHESKIKH REZONANSAKH V RESHENIYAKH URAVNENIYA LOU DLYA NEKOTORYKH MODELEI TEORII POLYA. (Dynamic Resonances in Low Equations for Certain Field Theory Models). B. M. Barbashov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 19p.

A possibility is investigated of dynamic resonances in the solutions of Low equations for some renormalized and non-renormalized models of the field theory. It is shown that the restriction on the coupling constant resulting from the requirement of the analiticity of the amplitude forbids the appearance of the dynamic resonances in the renormalizable cases. It turned turned out that the S-phase in the non-renormalized model of the scalar charged mesons behaves like the P-phase in the Chew Low model. (auth)

12430 (JINR-P-846) NABLYUDENIE EFFEKTA MESSBAUERA V Sm^{149}. (Mössbauer Effect in Sm-149). V. P. Alfimenkov, Yu. M. Ostanevich, T. Ruskov, A. V. Strelkov, F. L. Shapiro, Wu-kuang Yen (Joint Inst. for Nuclear Research. Lab. of Neutron Physics, Dubna, U.S.S.R.). 1961. 6p.

The Mössbauer effect is observed in Sm^{149} for 22-kev γ rays, thus proving that the γ transition from the 22-kev level to the ground state takes place in Sm^{149}. The upper limit of the natural width of the 22-kev level is determined to be 6×10^{-7} ev. (auth)

12431 (JINR-P-850) OBRAZOVANIE DEITONOV PRI VZAIMODEISTVII BYSTRYKH NUKLONOV S YADRAMI. (Production of Deuterons in Fast Nucleon Reaction with Nuclei). V. S. Barashenkov and V. M. Mal'tsev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 8p.

A large yield of deuterons in proton-nuclear interactions at $T \gg 1$ Bev can be accounted for in the peripheral interactions of primary protons with nuclei. Deuterons are generated in inelastic nucleon-nucleon interactions. (auth)

12432 (JINR-P-899) SPONTANNOE DELENIE S ANOMAL'NO KOROTKIM PERIODOM. II. (Spontaneous Fission with Abnormally Short Period. [Part] II). V. P. Perelygin, S. P. Almazova, B. A. Gvozdev, and Yu. T. Chubukrov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1962. 7p.

The tracks of the fragments for a spontaneously fissionable isotope obtained in bombarding U^{238} with 135-Mev Ne^{22} ions were detected using nuclear emulsions. The half life of this isotope was found to be (17 ± 7) msec, and its production cross section $\sim 3.10^{-32}$ cm^2 at the given energy of Ne^{22}. (auth)

12433 (NEVIS-102) THE SCATTERING OF 6-24 MEV NEGATIVE PIONS BY HYDROGEN. Enid Bierman (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.). Feb. 1962. Contract AT(30-1)-1932. 29p.

The scattering of negative pions at laboratory energies between 6 and 24 Mev was observed in a liquid H bubble chamber. The energy of each scattering was deduced from the ranges and angles of the scattered pion and recoil proton. Flux was measured by direct count of tracks of stopped pions. A maximum likelihood analysis was performed treating the strength of the small P-wave contribution as known. Based on 246 scattering events at a median energy of 13 Mev, the S-wave scattering length $a = (2\alpha_1 + \alpha_3)/3\eta$ is found to be 0.090 ± 0.005 when the large Coulomb contribution is assumed to be the non-relativistic amplitude for pure Coulomb scattering. Results are also presented with further Coulomb corrections. Values of α_1 are computed from the combination of this experimental result with experiments on $\pi^+ - p$ scattering. (auth)

12434 (NIRL/R/15) P.L.A. PROGRESS REPORT [FOR] 1961. (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England). 136p.

The operation, development, and instrumentation of the Rutherford Lab. proton linear accelerator in its first year of operation are discussed in some detail. Current projects on proton scattering and proton-induced reactions are described. Preliminary measurements of the polarization in scattering of 30-Mev protons by carbon are reported. Preliminary results are presented for the pickup reactions (p,d), (p,t), (p,He^3), and (p,α) of Pb^{208}. The processes involved in energetic protons coming to rest in NE102 plastic scintillator were studied. Optical model parameters were calculated for 17-Mev protons on copper, and the effects of total proton reaction cross sections on the optical model parameters were studied. Studies were made on the gamma radiation from the (p,γ) and (p,p'γ) reactions of C^{12}. The gamma spectra of Pm^{146} from the Nd^{146}(p,n) reaction were measured and used to derive a decay scheme for Pm^{146} The development of experimental techniques for proton reaction studies is described. (D.L.C.)

12435 (NP-11376) ON THE DOUBLET THEORY OF STRONG INTERACTIONS. Prem Prakash (Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas). 1961. 12p. (Notas de Física Vol. VIII, No. 14, p.237-47).

A general procedure is given for constructing interactions of baryons with bosons. The various particles are assumed to have different parities and a doublet scheme is used for baryons in which the doublets are eigenstates of parity operator. (J.R.D.)

12436 (NP-11419) CHARGE DEPENDENT NUCLEAR FORCES AND THE FERMI MATRIX ELEMENT. Technical Report 241. Albert Altman and William M. MacDonald (Maryland. Univ., College Park). Feb. 1962. 22p.

A charge-dependent potential is suggested to explain the decrease in the Fermi nuclear matrix element for the beta decay $O^{14}(O^+, T = 1) \rightarrow N^{14}(O^+, T = 1)$, required to obtain the discrepancy between the beta and μ decay polar vector coupling constants. This potential is determined from experimental data on the A = 14 nuclei and is found to be much too small to give the required reduction of the nuclear matrix element. (auth)

12437 (NYO-9284) CONTRIBUTIONS OF PION AND NUCLEON CURRENTS TO RADIATIVE MU-MESON CAPTURE BY A PROTON. Glenn Keith Manacher (Carnegie Inst. of Tech., Pittsburgh). May 1961. Contract AT(20-1)-882.

The matrix element and observables for radiative mu-meson capture by a proton were calculated for possible use as a model for capture on a J = 0 nucleus. The problem was treated in second-order perturbation theory. The effects of the nucleon and pion electromagnetic currents were included by taking into account the proton charge and neutron anomalous moments. The effects of the strong interactions on the weak vertices were also considered. Of the possible "effective" vertex operators V, A, P, and M, only P has a strong enough momentum transfer dependence to cause it to significantly differ from a constant in the reaction. This effect, however, is the principle one of several which enhance the role of Cp in radiative capture relative to its role in ordinary capture. The result was a sharp increase in the rate for capture on an unpolarized proton relative to a simple V-A theory, and a noticeable reduction of parity-violating effects. First-order terms derived from the application of gage invariance were added to the second order perturbation terms. These turned out not to have a large effect. "Higher" pionic effects, outside the perturbation theory, are also shown to have slight effects, once procedures for dealing with divergence difficulties are established. (auth)

12438 (NYO-9285) INELASTIC PROTON-PROTON SCATTERING AT 1.3 BEV. Nguyen Chi Hien (Carnegie Inst. of Tech., Pittsburgh). May 1961. Contract AT(30-1)-882. 118p.

The third external proton beam of the Cosmotron was impinged on a liquid hydrogen target. Protons scattered at a fixed angle were momentum-analyzed with a magnet spectrometer. The three angles studied were 2.37, 3.38, and 4.30°, at incident proton kinetic energies of 1.355, 1.351,

and 1.384 Bev, respectively. The momentum resolution given by the width of the elastic peak amounted to 2.3 to 4%. The inelastic proton spectrum showed clear evidence of the (3,3) resonance in π-p scattering. Calculations of the differential cross section per unit solid angle and momentum were made on the basis of isobar production by the one-pion exchange between the colliding protons, followed by isotropic decay of the isobar. Good agreement was obtained between measured and calculated spectra. This was considered to be evidence of the important role played by the peripheral interaction in single pion production by p-p collisions at 1.3 Bev. (auth)

12439 (SCR-466) NUCLEAR TEMPERATURES FROM NEUTRON BOMBARDMENT. R. I. Ewing (Sandia Corp., Albuquerque, N. Mex.) and T. W. Bonner (Rice Inst., Houston, Tex.). Feb. 1962. Contract [AT(29-1)-789]. 6p.

Based on talk given at American Physical Society meeting in Monterey, Calif., March 1961.

The energy spectra of neutrons inelastically scattered from Ta, W, Sn, Cd, and Fe were measured at incident neutron energies of 2.44, 5.0, and 7.0 Mev and analyzed to yield the nuclear temperature T and parameter a required to fit the equation $dN(E)/dE \cong E \exp(-E/T)$, where $T = \sqrt{E_b/a}$, E = energy of an emitted neutron, and E_b = energy of incident neutrons. The results indicate that the statistical theory of nuclear interactions is correct. (D.L.C.)

12440 (SRB-62-1) SCATTERING IN ION-ATOM AND ATOM-ATOM COLLISIONS: AN ANNOTATED BIBLIOGRAPHY. George E. Owens, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Jan. 1962. 84p.

Results of a search for experimental measurements on the scattering of ions in ion-atom and atom-atom collisions in the open literature from 1955 are presented. References are ordered by year of publication and by personal author. An index to secondary personal authors is included. Sources consulted include Nuclear Science Abstracts, 1955 to July 1961; Physics Abstracts, 1955 to July 1961; Physical Review, 1955 to July 1961; and current physics journals, January to July 1961. (auth)

12441 (TID-14957) PROGRESS REPORT ON [NUCLEAR PHYSICS], JANUARY 1, 1961–DECEMBER 31, 1961. Samuel K. Allison (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). Contract AT(11-1)-238. 56p.

Low-Energy Nuclear Physics. Total cross section measurements are reported for the charged particle reactions from bombardment of Li^7 and Li^6 with Li^6 and Li^7 nuclei at 2.1 Mev. Studies were made on the Be^9-Li^6 reaction at 2 Mev in an attempt to measure the $Be^9(Li^6,Li^7)Be^8$ reaction. An analysis was made on the energy spectrum of alphas from the $Li^6(Li^6,2\alpha)\alpha$ reaction at 2 Mev. Physics of Atomic and Ionic Beams. Preliminary measurements are reported for the stopping power of hydrogen gas for protons at 40 to 50 kev beam energy and the kinetic energy loss in the cyclic event whereby a proton first captures, and then loses, an electron. Progress is reported on measurement of helium beam stopping in gaseous and metallic cadmium. Measurements of the stopping power of hydrogen gas for helium and neon projectiles were extended to 80 to 190 kev. Various technical developments are described, including the production of cadmium foils and a study of the energy distribution of the kevatron beam. (D.L.C.)

12442 (TID- 15078) NUMERICAL CALCULATIONS OF MULTIPLE COULOMB EXCITATION CROSS SECTIONS. R. Graetzer, R. Hooverman, and E. M. Bernstein (Wisconsin. Univ., Madison). [1961]. Contract [AT(11-1)-Gen-7]. 12p.

Numerical results obtained in an extension of the calculations by Alder and Winter on cross sections for multiple E2 Coulomb excitation are presented. The results include a range of parameters particularly useful in the analysis of multiple E2 Coulomb excitation produced by heavy ions in tandem Van de Graaff accelerators. (J.R.D.)

12443 (TID-15119) THE SPECTRUM, THE EXCITATION AND IONIZATION CROSS-SECTIONS FOR PHOTO PROCESSES AND FOR COLLISIONS, OF FIVE TIMES IONIZED OXYGEN. Third Quarterly Report Covering Period December 1, 1961 to February 28, 1962. Carlos M. Varsavsky (P.E.C. Corp., Boulder, Colo.). Contract AT(11-1)-1017. 11p.

Activities are reported in a program to compute the inelastic collision cross sections for excitation and ionization of five-times ionized O. Work was initiated on an analysis of the Coulomb-Bethe approximation. A review of theoretical work concerning the approximation is presented including calculation of the transition integral and the establishment of an associated sensitivity criterion. It is noted that computations are under way but are not complete enough to allow inclusion of any numerical results. (J.R.D.)

12444 (TID-15124) ANNUAL REPORT ON NUCLEAR PHYSICS RESEARCH, FEBRUARY 1, 1961–JANUARY 31, 1962. Report No. 12. J. C. Harris, D. F. Herring, and K. W. Jones (Ohio State Univ. Research Foundation, Columbus). Jan. 31, 1962. Contract AT(11-1)-147. 45p.

The experimental program using the Ohio State University Van de Graaff Accelerator is described. Included are sections containing information concerning accelerator operation, the charged particle program, the neutron program, and nonenergetic gamma radiation investigations. (J.R.D.)

12445 (TID-15126) ENERGY AND ANGULAR DISTRIBUTIONS OF SECONDARY ELECTRONS FROM HELIUM GAS BOMBARDED BY PROTONS. M. E. Rudd (Nebraska. Univ., Lincoln). [1961?]. Contract AT(11-1)-35. 44p.

A study of secondary emission from He following bombardment of He gas by protons is proposed by measuring the angular and energy distribution of the electrons produced. A general description of the experiment is given which includes information on the experimental apparatus. Preliminary results using He gas indicate that electrons, if present have a negligible effect. Results also indicate that very few multiple collisions occur, and that no extraneous source of counts independent of the gas are present. (J.R.D.)

12446 (TID-15127) STOPPING POWERS OF HYDROCARBON VAPORS. John T. Park and E. J. Zimmerman (Nebraska. Univ., Lincoln). 1962. Contract AT(11-1)-35. 12p.

An apparatus was built to study the effects of molecular binding on hydrocarbon stopping powers. The differentially pumped gas cell can be set at temperatures for which the hydrocarbons being tested have suitable vapor pressures. The beam intensity reaching the secondary detector in the apparatus was insufficient to make a careful determination of the position of the maximum intensity. In order to obtain a usable current, a detector was designed using an electron multiplier tube to multiply the secondary electrons formed by the beam of protons striking the detector. Preliminary data on the stopping cross section of protons in helium and air are shown. (M.C.G.)

12447 (TID-15129) MEASUREMENTS OF $\Sigma_f\sigma_{of}$ BY ATTENUATION OF NEUTRAL OXYGEN ION BEAM IN A GAS IN THE PRESENCE OF A TRANSVERSE MAGNETIC

FIELD. Progress Report. Theodore Jorgensen, Jr. and Wayne Lang (Nebraska. Univ., Lincoln). 1962. Contract AT(11-1)-35. 7p.

Progress is reported in an experiment to measure cross sections for the charge-changing collisions of neutral O atoms in target gases of H, He, and O. Data on these cross sections are presented graphically. (J.R.D.)

12448 (TID-15130) STOPPING CROSS SECTIONS OF SOLID HYDROCARBONS FOR LOW ENERGY H^+ AND He^+ IONS. Chester A. Sautter and Edward J. Zimmerman (Nebraska. Univ., Lincoln). 1962. Contract AT(11-1)-35. 20p.

The status is reported of an experimental study on the energy loss for 40- to 340-kev H^+ and He^+ ions in passage through thin films of various plastics. Resulting data are included. (J.R.D.)

12449 (TID-15147) MASS AND CHARGE DISTRIBUTION STUDIES IN THE FISSION OF Np^{237} AND Pu^{239} BY INTERMEDIATE ENERGY HELIUM IONS (thesis). James Allen Powers (Purdue Univ., Lafayette, Ind.). Jan. 1962. Contract AT(11-1)-347. 124p.

Cross sections were determined for some twenty representative fission products in the fission of Np^{237} by 20.0-, 25.0-, 28.4-, 32.5-, 37.5-, and 40.5-Mev helium ions and for Pu^{239} by 21.5- and 32.0-Mev helium ions. Mass distribution curves constructed from the data were compared to certain other heavy element isotopes. Nuclear-radii were calculated from the sharp-cutoff potential nuclear model of Blatt and Weisskopf; an r_0 value of 1.41×10^{-13} was indicated. This value was in good agreement with previous radiochemical work on uranium isotopes and with alpha particle scattering data. The total cross sections also agreed fairly well with the diffuse-potential nuclear model proposed by Igo. The mass distribution for both isotopes was largely asymmetric in this energy region. The charge distribution was best explained by the constant charge ratio rule. (auth)

12450 (TID-15161) PART I. THE DECAY OF Ru^{105}, Pd^{109}, AND Rb^{86}. PART II. THE FISSION OF GOLD WITH INTERMEDIATE ENERGY HELIUM IONS (thesis). Henry William Brandhorst, Jr. (Purdue Univ., Lafayette, Ind.). Aug. 1961. Contract AT(11-1)-347. 98p.

In the course of radiochemical determinations of the fission mass yield curves of heavy element nuclides it became necessary to know the decay schemes of certain fission product isotopes. Of special interest were Ru^{105} and Pd^{109} as they are situated in the valley region of the mass yield distributions. Rb^{86} was studied because of the wide deviations in the published branching ratios. A decay scheme for Ru^{105} was proposed with levels existing at 130, 395 (or 530), 475, 685, 726, 795, 960, 1350, and 1720 kev. These levels are excited by beta groups of the maximum energies 1875, 1185, 1150, 1080, 915, 525, and 155 kev. A decay scheme for Pd^{109} having levels at 88, 217, 258, 307, 412, 719, and 860 kev was studied while the existence of 260 and 400 kev beta groups in addition to the 1030 kev beta ray was established. The half lives of Ru^{105}, Rh^{105}, and Pd^{109} were determined as 4.43 ± 0.02 hrs, 35.88 ± 0.02 hrs and 13.47 ± 0.01 hrs, respectively. The branching ratio of Rb^{86} was experimentally measured as $8.79 \pm 0.09\%$. The fission of elements lighter than Th is of interest because of the possibility of observing the relative amounts of symmetric and asymmetric fission modes. The fission mass yield distributions of Bi^{209} and natural Re both show the presence of an asymmetric mode and it was of interest to investigate those distributions resulting from the fission of gold. In this study, Au^{197} was bombarded with 32 to 41 Mev He ions. The fission product nuclides were separated radiochemically, purified from spallation product contamination by ion exchange, solvent extraction, and quantitative chemical separations and assayed in a low-level beta flow counter. The results appear to show that the mass yield distributions contain less than 1% of asymmetric fission down to a He ion bombarding energy of 32 Mev. The symmetric fission mode is highly energy sensitive, varying by a factor of 100 over the energy range investigated. The number of neutrons boiled off varied linearly from 5 at 40.4 Mev to 3 at 32.0 Mev. An independent yield was measured for Br^{82} at a He ion bombarding energy of 37.8 Mev which was consistent with a neutron "boil off" of 4.5. (auth)

12451 VARIATION PRINCIPLE FOR NUCLEAR ROTATIONS. Wilhelm Macke and Richard Lenk (Technische Universität, Dresden). Ann. Physik (7), 9: 1-13(1961). (In German)

For deformed, axially symmetric nuclei, solutions with a supplementary angular momentum perpendicular to the figure axis were derived from the variation requirement that the energy assume an extreme value under conditions of both constant normalization and given angular momentum. The exact solutions of this variation method are eigensolutions of the Hamilton operator H. If, however, one starts from a non-spherically symmetric model operator H^0, solutions arise which correspond to a nucleus rotating with the angular velocity $\vec{\omega}$. The expected values of energy and angular momentum depends in the first approximation quadratically or linearly on the angular velocity. The proportionality factor was interpretated as the moment of inertia of the nucleus. The inertia tensor is degenerated, the nucleus rotates only about an axis perpendicular to the figure axis. A general formula for the moment of inertia was given which takes into account the effect of interactions. (tr-auth)

12452 ROTATING NUCLEAR MODELS. Richard Lenk (Technische Universität, Dresden). Ann. Physik (7), 9: 79-96(1961). (In German)

Starting from a variation principle discussed in a previous article (Ann. Physik, 9: 1(1961)), approximation solutions were sought which give a model of a rotating nucleus, but within the framework of the model, describe the nucleus with optimum accuracy. Hartree-Fock methods and Brueckner theory were investigated as model approximations. For the nuclear moment of inertia, formulas were derived which represent a generalization of the formula of the "cranking model." The calculations, in connection with the results of Amado and Brueckner, indicate that the Hartree-Fock approximation leads to rigid ments of inertia and therefore not to agreement with the experimental values. The Brueckner method yields supplementary terms whose magnitudes are still unknown. (tr-auth)

12453 POLARIZATION IN NUCLEAR COLLISIONS WITH CHANNEL COUPLING. C. B. O. Mohr and C. A. Edvi-Illes (Univ. of Melbourne). Australian J. Phys., 14: 438-42(Dec. 1961).

The effect of the coupling between elastically and inelastically scattered waves on the polarization of particles scattered in nuclear collisions is considered for the simplest case of E0 excitations of the nucleus. The angular distribution of the polarization for elastic and inelastic collisions is sensitive to the magnitude of the coupling parameter (the transition potential). (auth)

12454 GAMMA-RADIATION ABSORPTION COEFFICIENTS OF VARIOUS MATERIALS ALLOWING FOR

BREMSSTRAHLUNG AND OTHER SECONDARY RADIATIONS. J. W. Allison (Defence Standards Labs., Melbourne). Australian J. Phys., 14: 443-68(Dec. 1961).

Calculations of the total absorption coefficient are generally based on the assumption that all the primary radiation energy converted into Compton-scattered radiation escapes from the material without significant absorption. This assumption is extended to include fluorescent and annihilation radiation and bremsstrahlung; new values of the photoelectric, Compton, pair production, and total absorption coefficients are determined at 0.01 to 100 Mev for hydrogen, nitrogen, oxygen, argon, aluminum, iron, lead, air, and water. Revised values of the total absorption coefficient, allowing for the Compton radiation energy loss only, are also determined. (auth)

12455 GAMMA-RAY SPECTRUM OF SHORT LIVED FISSION PRODUCTS. J. R. Keane (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Brit. J. Appl. Phys., 13: 131-3(Mar. 1962). (AERE-R-3627)

Fission products from uranium-235 irradiated by slow neutrons were analyzed using a gamma scintillation spectrometer. The spectra between 40 minutes and 40 hours after irradiation for 30 seconds were recorded and twelve major activities identified from their characteristic energies and rates of decay. (auth)

12456 DYNAMIC NUCLEAR POLARIZATION, APPLICATION TO THE PRODUCTION OF POLARIZED TARGETS. A. Abragam. Bull. inform. sci. et tech. (Paris), No. 55, 5-10(Oct. 1961). (In French)

The various methods of dynamic nuclear polarization used in magnetic resonance laboratories are presented and discussed. Different applications of these methods to the measurement of weak magnetic fields, the study of relaxation in liquids, the structure of metals and semiconductors, and nuclear physics are examined. (tr-auth)

12457 APPROXIMATE γ_5-INVARIANCE IN STRONG INTERACTION THEORY. A. A. Logunov, V. A. Meshcheryakov, and A. N. Tavkhelidze (Joint Inst. for Nuclear Research, Dubna, USSR). Doklady Akad. Nauk S.S.S.R., 142: 317-18(Jan. 11, 1962). (In Russian)

The appearance of properties of symmetry at high energies has been discussed recently. It is thought that vector bosons may occur by undergoing strong interaction in the following form: $L_{V.I.} = \Sigma_{\alpha=1}^{4} I_\alpha(x) B_\alpha(x)$, where B_α is the vector boson field, and I_α is the vector current of the strong interaction with $I_\alpha(x) = \Sigma g_i \bar{\Psi}_i \gamma_\alpha \Psi_i$. It is hypothesized that the matrix elements of all physical processes are invariant with respect to the γ_5-transformations of the spinor particles at high energy and momentum transfer. It is shown that the magnetic form-factor of a nucleon decreases, if the momentum transfer is sufficiently large. If there is no change in the relative parity of the particles, it is shown that the final fermion is longitudinally polarized, if the initial fermion is longitudinally polarized. In addition, if the initial state is not polarized, the final state is not polarized. The expression for the scattering amplitude can be considerably simplified for nucleon-nucleon scattering at high energies. (TTT)

12458 STUDY OF THE STRIPPING REACTIONS $Ne^{20,22}(d,n)Na^{21,23}$ BY COLLIMATION SPECTROMETRY OF THE RECOIL PROTONS. W. Grueebler and J. Rossel (Université, Neuchatel, Switzerland). Helv. Phys. Acta, 34: 718-56(1961). (In French)

Energy spectrum and absolute differential cross section were measured for the reactions $Ne^{20,22}(d,n)Na^{21,23}$ with a gas target of either natural neon or of the separated isotopes, and with deuterons of 2.83 Mev. The characteristics of the collimated recoil proton fast neutron spectrometer used for these experiments are described in detail. The results may be summarized as follows: In Na^{23} known levels at 3.90, 4.45, 4.75, 6.27, and 7.21 Mev and two new levels at 5.16 and 7.72 Mev were observed. For Na^{21}, neutron groups corresponding to the ground state and to a level at 0.33 Mev were found; the previously reported level at 1.47 Mev was not confirmed. From the main peak in the angular distribution and using the simple plane wave theory, parity and tentative spin assignments for the final levels as well as the reduced widths are presented. From the discussion it appears that the 7.72 Mev level in Na^{23} is probably the first level with isospin $^3/_2$ Despite the low deuteron energy, the form of the angular distribution in the forward hemisphere is reasonably well described in the stripping approximation of Butler. The disagreement, in the backward direction, suggests a distorted wave calculation to improve the fit. (auth)

12459 DECAY SCHEME OF Eu^{149}. Fu-chün Wang, I. Vizi, K. Gromov, B. Dzhelepov, Zh. Zhelev, A. Kudryavtseva, and Yu. Yazvitskii. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 114-19(Jan. 1962). (In Russian)

A triple-focusing β spectrometer was used for determining the electron conversion spectra of Eu^{149}($T_{1/2}$ = 90d) separated from a tantalum target bombarded by 660-Mev protons. Conversion lines at 256, 279, 330, 352, 508, and 530 kev were found and analyzed. The x-ray coincidences indicate that the excited levels of Sm^{149} have a half life of 10^{-6} sec. (R.V.J.)

12460 CONVERSION ELECTRONS OF SHORT-LIFE Pt AND W ISOTOPES. E. P. Grigor'ev, B. S. Dzhelepov, V. Zvol'ska, A. V. Zolotavin, T. V. Malysheva, B. A. Khotin, and J. Adam (Leningrad State Univ.; Joint Inst. for Nuclear Research, Dubna, USSR; and Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 120-4(Jan. 1962). (In Russian)

Electron conversion spectra of platinum at 68 to 106 kev and tungsten at 70 to 90 kev were studied with a double-focusing $\pi\sqrt{2}$ β spectrometer and by direct nuclear magnetic resonance measurements. The neutron deficient Pt and W isotopes were produced by deep spallation of gold by 660-Mev protons. The energies and intensities of Pt are tabulated, and a new half life ($T_{1/2}$ = 2.5 hours) was found for W^{176}. (R.V.J.)

12461 NEUTRON-DEFICIENT TANTALUM ISOTOPES. T. V. Malysheva, L. P. Moscaleva, G. M. Chernov, and L. V. Filatova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, [Moscow]). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 125-6(Jan. 1962). (In Russian)

Neutron-deficient tantalum isotopes produced by 660-Mev proton spallation of gold were studied with a 100-channel γ spectrometer. Ta^{175} was identified by measuring the activity Hf^{175}, which after three months exhibited 340 and 230 kev γ lines. The half life of Ta^{175} was determined to be 10 ± 1 hours. The half life for Ta^{173} was found to be 3.5 ± 0.2 hours. The total decay curve of the tantalum fraction contained periods of 1.2, 4, 12, and 53 hours. The 1.2 hour period belongs to Ta^{174}. (R.V.J.)

12462 ON ROTATIONAL ORIGIN OF ISOMERIC LEVEL IN $_{71}Lu_{105}^{176*}$ ($T_{1/2}$ = 3.7). I. Řezanka, J. Frána, J. Adam, and L. Peker (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, [Prague] and Leningrad State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 127-30(Jan. 1962). (In Russian)

Measurements made with prepared Lu^{176*} showed that the isomeric state of $_{71}Lu_{105}^{176*}$ ($T_{1/2}$ = 3.7 hours) with I = 1 is

described by K = 0, verifying the postulation of L. K. Peker (Tenth Conference on Nuclear Spectroscopy, Moscow, Jan. 1960) on the rotational nature of this isomer. (R.V.J.)

12463 MOTION OF NUCLEONS IN DEFORMED LIGHT NUCLEI. B. I. Tishchenko, A. A. Kresnin, and E. V. Inopin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 138-47 (Jan. 1962). (In Russian)

The motion of nucleons in deformed light nuclei is calculated by means of a Hamiltonian suggested by S. G. Nilsson (Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 29: No. 16, 1955). However, the resolving method used is quite different, being based on the utilization of a small spin-orbit interaction constant ($\kappa \sim 0.1$) which enables precise calculation of sufficiently large deformation parameters ($\delta \sim 0.5$). The method is a modification of the method used by D. V. Volkov et al. (Zhur. Eksptl. i Teoret. Fiz., 38: 1960) in the problem of a non-axial anisotropic oscillator with spin-orbit interaction. (R.V.J.)

12464 SCREENING EFFECTS FOR FORBIDDEN β^- SPECTRA. L. N. Zyryanova (Leningrad State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 148-9(Jan. 1962). (In Russian)

The screening effect for the first and second forbidden spectra was analyzed, and electron wave functions L, M, N, P, Q, and R are calculated considering the Coulomb field, finite de Broglie wave length, and finite nuclear radius. Calculations were made for an evenly charged nuclear model with radius $R = 1.2\ A^{1/3} \times 10^{-13}$ cm. Screening corrections for M_0 and N_0 are less than 0.5% and not over 6% for P_0, Q_0, and R_0. (R.V.J.)

12465 CORRECTIONS FOR ALLOWED β SPECTRA DEVLEOPED BY CONSIDERING MATRIX ELEMENTS OF RELATIVISTIC OPERATORS α AND γ_5. L. N. Zyryanova and A. A. Pantyushin (Leningrad State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 150-2(Jan. 1962). (In Russian)

Beta transitions are analyzed by considering that the leptons are present as plane waves $\sim \exp(-iK \cdot x)$, where $K = p_e + p_\nu$ and the exponential is replaced by a unit. Relativistic operators $\vec{\alpha}$ and γ_5 are not considered (it is assumed that VA interaction takes place). Corrections of relativistic matrix elements for allowed transitions $P^{32} \rightarrow S^{32}(1^+ \rightarrow 0^+)$ and $Na^{22} \rightarrow Ne^{22}(3^+ \rightarrow 2^+)$ are plotted. It is shown that the corrections $0.25 \times 10^{-2}(1/mc^2)$ are not explained by the experimentally observed deviation of P^{32} and Na^{22} spectra from the statistical magnitude (4 to 5) $\times 10^{-2}(1/mc^2)$. Corrections for B^{12}, N^{12}, and In^{144} at the mc^2 energy are identical. Corrections for matrix elements of the second forbiddens are from $0.1 \times 10^{-2}(1/mc^2)$ up to $0.25 \times 10^{-2}(1/mc^2)$, and also cannot be explained by the observed deviation. (R.V.J.)

12466 COLLECTIVE LEVELS AND DEFORMATION OF NUCLEI WITH THE NUMBER OF NEUTRONS N = 82 TO 90. V. I. Popov (Lebedev Inst. of Physics, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 153-60(Jan. 1962). (In Russian)

An analysis of nuclear properties at Z = 58 to 61 indicated that the use of the vibration model is limited. An increased number of neutrons in the super-saturated shell N = 82 enhances the effective deformation of nuclei and defects them from their equilibrium shape in spherical symmetry. The lower collective levels of even-even nuclei with N = 88 are well described by the rotator model with a large effective non-axiality caused by the axial symmetry of equilibrium nuclei and, to a certain degree, by γ oscillations. (R.V.J.)

12467 REDETERMINATION OF THE He–He INTERACTION BETWEEN 0.55 AND 1.0 A. I. Amdur and R. R. Bertrand (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 36: 1078-9(Feb. 15, 1962).

Experimental values of the He–He potential are tabulated. No correction was made for inelastic scattering resulting from electronic excitation or ionization because of the lack of a satisfactory theory or phenomenological treatment on which to base such corrections. The geometry of the apparatus was such that most inelastic scattering could not be seen by the beam detector, and even for the most energetic collisions not more than about 5% of the observed scattering might be assigned to detectable inelastic collisions producing excitation or ionization. However it is recommended that the old values of $\phi(r)_I$ be replaced by the corresponding values of $\phi(r)_{II}$ as a representation of the experimentally determined interaction between 0.55 and 1.0 Å. (P.C.H.)

12468 YTTRIUM-96 AND STRONTIUM-93: NEW NUCLEAR DATA. D. G. Vallis and J. L. Perkin (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Inorg. & Nuclear Chem., 22: 1-5(Dec. 1961).

Targets of Zr^{96} were irradiated with 14.5 Mev neutrons and the decay of the resultant β-particle and γ-ray activity was found to have two compenents with half lives of 2.3 and 8.3 min. Only the shorter lived component was present in yttrium fractions chemically separated from the targets. This activity was assigned to the previously unreported isotope Y^{96} produced by the reaction $Zr^{96}(n,p)Y^{96}$. The longer-lived component was due to the (n,a) product Sr^{93} whose half life was reported previously. Other details are as follows: Y^{96}: $T_{1/2}$ 2.3 ± 0.1 min; Eβ max 3.5 Mev; Eγ 0 – 2.5 Mev, resolved peaks at 0.7 and 1.0 Mev; and Sr^{93}: $T_{1/2}$ 8.3 ± 0.5 min; Eβ max 2.0 Mev; Eγ 0 – 2 Mev, resolved peaks at 0.6 and 2.0 Mev. The short-lived Y^{96} was chemically separated from other activation products using an automatically controlled centrifuge. The apparatus, which has some novel features and may be employed for other rapid chemical separations, is described in detail. (auth)

12469 DECAY PROPERTIES OF THE ^{117}In ISOMERS. J. H. Wolfe and J. P. Hummel (Univ. of Illinois, Urbana). J. Inorg. & Nuclear Chem., 22: 7-11(Dec. 1961).

Samples of $In^{117-117m}$ were produced by the $Sb^{121}(\gamma,\alpha)$ reaction and studied by gamma-ray spectroscopy techniques. The analysis of the decay curves for the various photopeaks gives a 1.9 ± 0.1 hr half life for In^{117m} which agrees with the previous value and 43 ± 4 min for In^{117} which is shorter than the previous value. An analysis of the intensities of the γ rays gives the following intensities for the various decay branches in In^{117m}: 28% 311 kev isomeric transition, 21% 1.616 Mev β transition, and 51% 1.772 Mev β transition. This gives slightly more isomeric transition than previously reported. (auth)

12470 SOME NEUTRON-DEFICIENT ISOTOPES OF THULIUM AND ERBIUM. A SURVEY OF HALF-LIVES AND γ-RAY SPECTRA WITH THE USE OF MASS-SEPARATED SAMPLES. S. Bjoernholm, H. L. Nielsen, G. Sidenius, O. Skilbreid, and Å. Svandeden (Universitets Institut for Teoretisk Fysik, Copenhagen). J. Inorg. & Nuclear Chem., 21: 193-200(Dec. 1961).

Neutron-deficient isotopes of Tm and Er were produced in Er(p,xn)-reactions. Chemical separation, as well as mass-separation of the products, was performed, and the half lives and γ-ray spectra of the individual samples were measured. Definite mass assignments of the activities were made, and previously reported results essentially confirmed. (auth)

12471 ISOMERIC CROSS-SECTION RATIO FOR THE (α,pn) REACTION. G. R. Choppin and T. Sikkeland (Univ. of California, Berkeley). J. Inorg. & Nuclear Chem., 21: 201-4(Dec. 1961).

Isomeric cross section ratios were measured at α bombarding energies up to 40 Mev for the formation of Es^{254} isomers from Cf^{252}. The high-spin isomer was not observed, and a lower limit of 34 could be set for the cross-section ratio (low spin/high spin). (auth)

12472 CHEMICAL EFFECTS OF β-DECAY FROM ^{132}Te TO ^{132}I. B. C. Cummiskey, W. H. Hamill, and R. R. Williams, Jr. (Univ. of Notre Dame, Ind.). J. Inorg. & Nuclear Chem., 21: 205-9(Dec. 1961).

The chemical form of daughter iodine activity produced by β decay of Te^{132} in the presence of iodine carriers was investigated. Three forms of iodine can be distinguished: periodate, iodate, and reduced forms. The distribution among these forms was found to be partly dependent on the nature of substances present during growth and also on the oxidation state of the tellurium parent. (auth)

12473 STATISTICAL THEORY OF THE ENERGY LEVELS OF COMPLEX SYSTEMS. [PART] I. Freeman J. Dyson (Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys., 3: 140-56(Jan.-Feb. 1962).

New kinds of statistical ensemble are defined, representing a mathematical idealization of the notion of "all physical systems with equal probability." Three such ensembles are studied in detail, based mathematically upon the orthogonal, unitary, and symplectic groups. The orthogonal ensemble is relevant in most practical circumstances, the unitary ensemble applies only when time-reversal invariance is violated, and the symplectic ensemble applies only to odd-spin systems without rotational symmetry. The probability-distributions for the energy levels are calculated. Repulsion between neighboring levels is strongest in the symplectic ensemble and weakest in the orthogonal ensemble. An exact mathematical correspondence is found between these eigenvalue distributions and the statistical mechanics of a one-dimensional classical Coulomb gas at three different temperatures. An unproved conjecture is put forward, expressing the thermodynamic variables of the Coulomb gas in closed analytic form as functions of temperature. By means of general group-theoretical arguments, the conjecture is proved for the three temperatures which are directly relevant to the eigenvalue distribution problem. The electrostatic analog is exploited in order to deduce precise statements concerning the entropy, or degree of irregularity, of the eigenvalue distributions. (auth)

12474 STATISTICAL THEORY OF THE ENERGY LEVELS OF COMPLEX SYSTEMS. [PART] II. Freeman J. Dyson (Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys., 3: 157-65(Jan.-Feb. 1962).

The distribution function of spacings S between nearest neighbors, in a long series of energy levels with average spacing D, is studied. The statistical properties of S are defined in terms of an ensemble of systems described in a previous paper. For large values of $t = (\pi S/2D)$, it is shown that the distribution of S can be deduced from the thermodynamical properties of a certain model. The model, which replaces the eigenvalue distribution by a continuous fluid, can be studied by the methods of classical electrostatics, potential theory, and thermodynamics. The distribution function of spacings S is found to be asymptotically $Q(t) = At^{\frac{1}{2}} \exp[-\frac{1}{4}t^2 - \frac{1}{2}t]$ for large t. The numerical constant A can in principle not be determined from such a continuum model. Reasons are given for considering the remaining factors in the formula for Q(t) to be reliable. (auth)

12475 STATISTICAL THEORY OF THE ENERGY LEVELS OF COMPLEX SYSTEMS. [PART] III. Freeman J. Dyson (Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys., 3: 166-75(Jan.-Feb. 1962).

A systematic method is developed for calculating the n-level correlation-function $R_n(x_1,\ldots,x_n)$, defined as the probability for finding n levels at positions $(x_1,\ldots,x_n)$, regardless of the positions of other levels. It is supposed that the levels of a complex system are statistically equivalent to the eigenvalues of a random symmetric unitary matrix of order $N \gg n$, according to the general theory. The 2-level correlation-function is $R_2(x_1,x_2) = 1 - \{s(r)\}^2 - \{\int_r^\infty s(t)dt\}\{ds(r)/dr\}$, $s(r) = [\sin(\pi r)/\pi r]$, $r = |x_1 - x_2|$, the scale of energy being chosen so that the mean level-spacing is unity. It is shown how this result could in principle be used in order to determine the proportions of levels in two uncorrelated and superimposed series. An analytic expression for the distribution of nearest-neighbor level-spacings, discovered by Gaudin and Mehta, is rederived, and a similar expression is found for the distribution of spacings between next-nearest neighbors. An unexplained identity relates the nearest and next-nearest neighbor spacing distributions of a system invariant under time-reversal to the level-spacing distribution of a system without time-reversal invariance. (auth)

12476 ISOTOPE SHIFT IN THE FIRST SPECTRUM OF SILICON (Si I). John R. Holmes and Martin E. Hoover (Univ. of Southern California, Los Angeles). J. Opt. Soc. Am., 52: 247-50(Mar. 1962).

Isotope shifts of Si^{30} relative to Si^{28} were observed in eleven ultraviolet lines of the neutral silicon spectrum. The spectra of two highly enriched samples of elemental silicon were excited separately in two hollow-cathode discharge tubes cooled in liquid nitrogen. An externally mounted Fabry-Perot interferometer, used in connection with a medium Hilger, quartz-prism spectrograph, provided the high resolution necessary for these observations. The magnitudes of the observed shifts vary from $\Delta\nu \sim 0.011 \pm 0.001$ cm^{-1} for the ($3p^2\ ^3P - 4s\ ^3P^0$) transition to $\Delta\nu \sim 0.115 \pm 0.002$ cm^{-1} for the ($3p^2\ ^3P - 3a\ ^3D^0$) transition. (auth)

12477 TRENDS IN NUCLEAR REACTION CROSS SECTIONS. I. THE (n,p) REACTION INDUCED BY 14 MeV NEUTRONS. Donald G. Gardner (Univ. of Arkansas, Fayetteville). Nuclear Phys., 29: 373-99(Jan. 1962). (In English)

A compilation of all reported (n,p) cross sections induced by neutrons at about 14 Mev was made. A study of these experimental values revealed trends which permitted the prediction of the (n,p) cross sections at 14 Mev of all of the isotopes of all elements with atomic numbers in the range $6 \leq Z \leq 94$, except for five elements. The cross sections are predicted using an equation that is a function only of the atomic number and the atomic weight. The equation also states that the cross section of each succeeding isotope for a given atomic number is one-half of the value of the preceding isotope. The equation is compared with the statistical model. (auth)

12478 DISTORTED WAVE ANALYSIS OF THE INELASTIC SCATTERING OF PROTONS AND THE 9.63 MeV STATE OF C^{12}. E. Bradford and B. A. Robson (Australian National Univ., Canberra). Nuclear Phys., 29: 442-51(Jan. 1962). (In English)

A spin assignment of 3 for the 9.63-Mev state in C^{12} was made using a distorted wave analysis of the inelastic scattering of 18.9-Mev nucleons. The expected degree of polarization was calculated. (auth)

12479 MEASUREMENTS OF K SHELL PHOTOELECTRIC CROSS SECTIONS. E. J. Bleeker, P. F. A. Goudsmit, and C. De Vries (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nuclear Phys., 29: 452-61(Jan. 1962). (In English)

K-shell photoelectric cross sections for lead were determined using an iron-free double-focusing beta spectrometer. Comparison of intensities of internal and external conversion lines from the 1.332-Mev gamma transition following the decay of Co^{60} gave $\tau_K = (3.24 \pm 0.13)$ b per atom. The ratio of the cross sections at 2.754 and 1.368 Mev gamma transitions following the decay of Na^{24} is 0.30 ± 0.02, as found by comparison of intensities of the external conversion lines. The cross section at 2.754 Mev calculated from the above mentioned values is (0.93 ± 0.07) b per atom. These results support calculations for K-shell photoelectric cross sections. (auth)

12480 MEASUREMENT OF PROTON INELASTIC CROSS SECTIONS BETWEEN 77 MeV AND 133 MeV. R. Goloskie and K. Strauch (Harvard Univ., Cambridge, Mass.). Nuclear Phys., 29: 474-85(Jan. 1962). (In English)

The proton inelastic cross sections of carbon, aluminum, copper, silver, and lead were measured at 77 to 133 Mev using the external beam of the Harvard cyclotron. The measurements are made using a specially designed range telescope located in the external beam of the cyclotron. The cross sections are nearly constant in the energy range covered and average 0.225 ± 0.005 b for carbon, 0.423 ± 0.009 b for aluminum, 0.763 ± 0.021 b for copper, 1.060 ± 0.025 b for silver, and 1.743 ± 0.040 b for lead. The lead and, to some extent, the silver inelastic cross sections seem to decrease with increasing energy within the 3% experimental error. The proton inelastic cross sections of the heavier elements, when corrected for the Coulomb repulsion of the nucleus, are significantly higher than the neutron inelastic cross sections. Optical model calculations can be interpreted as indicating a difference in the spatial distribution of protons and neutrons in these nuclei. (auth)

12481 ELECTROMAGNETIC SUM RULES. Geoffrey I. Opat (Univ. of Melbourne, Parkville, Victoria, Australia). Nuclear Phys., 29: 486-95(Jan. 1962). (In English)

Using invariance properties under rotation in configuration and isobaric spin spaces, specific electromagnetic sum rules are derived for transitions from a given initial state to states of a given total angular momentum and total isobaric spin. Applications to photonuclear reactions are discussed. (auth)

12482 OPTICAL MODEL ANALYSIS OF $Mg^{24}(d,p)Mg^{25*}$ AT 10.1 MeV. B. Buck and P. E. Hodgson (Clarendon Lab., Oxford). Nuclear Phys., 29: 496-506(Jan. 1962). (In English)

Experimental results of R. Middleton and S. Hinds on the (d,p) stripping reaction on Mg^{24} leading to a series of excited states of Mg^{25} are analyzed using the distorted wave Born approximation with optical model wave functions. (auth)

12483 MIXING OF THE γ-VIBRATIONAL BAND AND THE GROUND STATE ROTATIONAL BAND OF Pu^{238}. J. Borggreen, O. B. Nielsen, and H. Nordby (Univ. of Copenhagen). Nuclear Phys., 29: 515-21(Jan. 1962). (In English)

The conversion lines of Pu^{238} following the β-decay of Np^{238} were remeasured. The branching ratios for the γ rays de-exciting the γ-vibrational band at 1030 kev were analyzed and a mixing parameter $z \approx 0.025$ is found. The dependence of the mixing on M1 transition probabilities and on the deviations from the $I(I+1)$ law for the rotational energies is discussed. (auth)

12484 ALPHA PARTICLES FROM THE INTERACTION OF 14 MeV NEUTRONS WITH ARSENIC. O. N. Kaul (Saha Inst. of Nuclear Physics, Calcutta). Nuclear Phys., 29: 522-6(Jan. 1962). (In English)

Energy and angular distribution of alpha particles from the $As^{75}(n,\alpha)Ga^{72}$ reaction were studied using the emulsion technique. The area under the energy distribution shows that the number of alpha particles emitted below the Coulomb barrier is more than is expected from the statistical theory. The angular distribution about the center-of-mass system is roughly symmetrical about 90°, and concave upwards. The relative level density plotted from the energy distribution fits a straight line, except on the low energy side, and corresponds to a nuclear temperature of 0.7 Mev. The total cross section is estimated to be 29 mb ± 10%. (auth)

12485 NUCLEAR MODELS, THRESHOLD STATES AND REARRANGEMENT ENERGY. D. R. Inglis (Argonne National Lab., Ill.). Nuclear Phys., 30: 1-29(Feb. 1962). (In English)

When a parameter such as the nuclear radius is varied to raise the energy of a nuclear state toward the top of a potential barrier, the rate of rise is decelerated by the penetration of the barrier and the consequent spreading out of the wave function. This enhances the probability that states will be found in the energy intervals where this penetration becomes large. Empirically there seems to be a small enhancement having about the estimated magnitude, although there are too few cases to be sure. The separation energy of a nucleon leaving a nucleus is determined not only by the breaking-off of its interactions with the other nucleons but also by the rearrangement energy Δ. The outer "tail" of the wave function of a bound nucleon is limited by a potential barrier determined only by the breaking of the interactions, without benefit of rearrangement. The shell-model potential that confines wave functions thus has a barrier height $B + \Delta$, higher by Δ than the separation energy barrier B. The harmonic oscillator wave functions are a better approximation to wave functions thus confined than would be expected without recognition of this role of rearrangement energy. In cases in which the last nucleon is very slightly bound so that its amplitude inside the nucleus may be small (as in Be^9), and particularly when the residual nucleus consists of closed shells relatively little-influenced by the last nucleon (as for the proton in F^{17}), the rearrangement energy is expected to be exceptionally small. That these wave functions are not narrowly confined is thus consistent with the confining role of Δ in normally bound states. The rearrangement barrier seems to have been observed in a high-energy (p, 2p) reaction. The plausible assumption that rearrangement energy Δ is roughly proportional to the probability of the bound nucleon being inside the nuclear potential well influences in a peculiar way the likelihood of finding a state near threshold. There is a sort of regenerative effect. As the level is raised toward or slightly beyond threshold, the increased penetration of the rearrangement barrier $B + \Delta$ decreases the amplitude of the internal part of the wave function. This in turn decreases Δ and lowers the barrier $B + \Delta$, thus further increasing the penetration. If the intrinsic rearrangement energy is rather small, the result is to increase the already somewhat enhanced likelihood of finding a state near threshold. (auth)

12486 GAMMA-RAY BRANCHING OF ENERGY LEVELS IN ^{24}Mg FROM THE ^{23}Na(p,γ)^{24}Mg REACTION. P. W. M. Glaudemans and P. M. Endt (Rijksuniversiteit, Utrecht). Nuclear Phys., 30: 30-48(Feb. 1962). (In English)

The gamma spectra at six $Na^{23}(p,\gamma)Mg^{24}$ resonances in the 300 to 750 kev proton energy region are investigated with scintillation spectrometers. From single spectra, coincidence spectra, and sum-coincidence spectra, the gamma branchings of the resonance levels and of eighteen lower Mg^{24} levels are obtained. At most resonances a 1.63-Mev gamma ray is observed, from which the relative intensity of the $Na^{23}(p,\alpha_1)Ne^{20}$ decay can be found. Thick target gamma yields are measured, from which the resonance strengths are obtained. (auth)

12487 REACTION MECHANISM AND SHELL EFFECTS FROM THE INTERACTION OF 14.6 MeV NEUTRONS WITH NUCLEI. P. Strohal, N. Cindro, and B. Eman (Institute "Rudjer Bošković," Zagreb). Nuclear Phys., 30: 49-67 (Feb. 1962). (In English)

The total cross sections for (n, 2n), (n, p), and (n, α) reactions are measured for several nuclei around Z = 40 by the activation method, and the predictions of compound nucleus theory compared with experiment. Pairing and shell corrections are used in the calculations. While the cross sections for (n, 2n) reactions agree fairly well with the statistical model, the (n, p) and (n, α) cross sections are mostly below the calculated values, the discrepancy being stronger for α emission. The impossibility of fitting the data with the statistical model is interpreted as being caused by the presence of direct processes, whose influence is intensified by the Coulomb barrier. Direct evidence for strong correlation between shell effects and total reaction cross section is found for nuclei with neutron number N = 50. The cross sections for (n, 2n) reactions show a minimum at N = 50, while the competing (n, p) reactions show a strong maximum. The ratio σ_m/σ_g is measured for several isomeric states. The cross sections for (n, p) and (n, α) reactions for different isotopes of the same element are found to obey the general trend of decreasing with increasing neutron number. (auth)

12488 DECAY OF Y^{86} AND EXCITED STATES IN Sr^{86}. Toshimitsu Yamazaki, Hidetsugu Ikegami, and Mitsuo Sakai (Tokyo Univ.). Nuclear Phys., 30: 68-92(Feb. 1962). (In English)

A nuclear level scheme for Sr^{86} relevant to the decay of 14.6-h Y^{86} is investigated. Coincidence studies and gamma-gamma directional correlation experiments are also performed. The positron spectrum consists of several components with maximum energies of 3.13 (0.6%), 2.32 (0.6%), 1.96 (3.9%), 1.18 (18%) Mev, etc. The first component feeds the first excited state and has a spectral shape characteristic of a first unique forbidden transition. The spin and parity of Y^{86} are uniquely assigned as 4−. The following transitions (in Mev) are observed in the spectra of internal and external conversion electrons and in the scintillation spectra: 0.181(w), 0.437 (18%), 0.510 (17%), 0.578(w), 0.606(w), 0.627 (35%), 0.643 (9%), 0.704 (22%), 0.711(w), 0.779 (29%), 0.841 (8%), 1.030 (6%), 1.084 (100%), 1.161 (40%), 1.168(w), 1.261 (4%), 1.360 (5%), 1.428(w), 1.867 (27%), 1.937 (25%), 2.58 (4%), 2.83(w), 3.30(w), and 3.75(w) where w means weak. Assignments of multipolarity are made, and a decay scheme is proposed. It involves the following energy levels (in Mev): 1.084, 2+; 1.925, 2+; 2.245, 4+; 2.951, (4+); 3.021, (3+); 3.461, (4−); 3.578, (5−); 3.660, (3±, 4+); 3.91, (3, 4+); 4.22, (4, 5−); 4.38, (3, 4+); 4.83, (3, 4+); and 4.93, (4, 5−). (auth)

12489 CROSS SECTIONS FOR THE PRODUCTION OF GAMMA-RAYS BY THE INELASTIC SCATTERING OF NEUTRONS FROM IRON. J. H. Montague and E. B. Paul (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 30: 93-109(Feb. 1962). (In English)

The cross sections for the production of gamma rays by inelastic neutron scattering from iron were measured for incident neutron energies up to 3.8 Mev. The gamma rays observed had energies of 0.84, 1.26, 1.41, 1.81, 2.10, 2.26, 2.6, 3.0, and 3.3 Mev. (auth)

12490 ON THE SCHEME OF THE $Eu^{149} \rightarrow Sm^{149}$ DECAY. B. S. Dzhelepov, K. Gromov, A. Kudryavtseva, Fu-ch'ing Wang (Van Fu-Tsin), I. Vizi, Yu. Yazvitsky, and Zh. Zhelev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). Nuclear Phys., 30: 110-19(Feb. 1962). (In English)

The $Eu^{149} \rightarrow Sm^{149}$ decay was investigated. The Eu preparation was isolated from a tantalum target that was irradiated by 660 Mev protons. Apart from the γ-transitions with energies 256, 279, and 330 kev, five transitions were found: 530, 508, 352, 178, and 22 kev. The Eu^{149} decay scheme was given. (auth)

12491 ON THE Eu^{147} DECAY SCHEME. B. S. Dzhelepov, K. Gromov, I. Vizi, Yu. Yazvitsky, and Zh. Zhelev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). Nuclear Phys., 30: 120-5(Feb. 1962). (In English)

The hard part of the Eu^{147} conversion electron spectrum and γ-γ coincidences in the Eu^{147} decay were investigated. The Eu preparation was isolated from a tantalum target irradiated by 660-Mev protons. A direct transition at 900 kev was established and three γ-transitions were found with energies 880, 780, and 700 kev. The results confirmed the existence of 121, 198, 800, and 1080-kev levels and made possible the introduction of a 900-kev level into the Sm^{147} level scheme. (auth)

12492 STUDY OF THE Tb^{152} POSITON AND CONVERSION ELECTRON SPECTRUM. B. S. Dzhelepov, K. Gromov, A. V. Kudryavtseva, and Zh. T. Zhelev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). Nuclear Phys., 30: 126-30(Feb. 1962). (In English)

The β^+ and conversion electron spectra of Tb^{152} were studied using a beam triple-focusing β-spectrometer. (auth)

12493 ANGULAR CORRELATION STUDY OF THE $Be^9(\alpha,n)C^{12*}$ ($\gamma_{4.43}$)C^{12} REACTION. J. Kjellman, T. Dazai, and J. H. Neiler (Oak Ridge National Lab., Tenn.). Nuclear Phys., 30: 131-9(Feb. 1962). (In English)

The angular correlation between the neutrons to the 4.43-Mev state and the γ rays from this level to the ground state in C^{12} for the reaction $Be^9(\alpha,n\gamma)C^{12}$ was studied at a bombarding energy of 3.35 Mev. The correlations were measured both in the reaction plane and the azimuthal plane at four different neutron detector angles, viz. −10, −20, −75, and −135°. The correlation for a certain angle was first measured in the reaction plane and the correlations in the azimuthal plane were then measured around and parallel to the symmetry axis found in the reaction plane. The symmetry axis for the different angles was found to be −5, −15, −50, and −85°, respectively. (auth)

12494 HIGHLYING STATES IN Sn^{116} POPULATED IN THE DECAY OF 54 MIN In^{116m}. P. G. Hansen, H. L. Nielsen, and K. Wilsky (Research Establishment Risø, Denmark). Nuclear Phys., 30: 140-7(Feb. 1962). (In English)

The decay of 54−min In^{116m} is investigated by coincidence techniques. The 410 and 135 kev transitions are found to differ from the 404 and 137 kev transitions known from the decay of 1-h Sb^{116}. There is no evidence for a

second 410 kev ray in the In^{116m} decay. The level scheme is compared with calculations. (auth)

12495 DECAY OF 27-h Ho^{166}. J. E. Cline, E. C. Yates, and E. H. Turk (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Phys., 30: 154-62(Feb. 1962). (In English)

Three gamma rays are observed following the decay of 27-h Ho^{166}, representing cascade transitions in Er^{166} from the (0, 0+) level at 1460 kev through the (2, 2+) level at 787 kev. The presence of two high-energy gamma transitions is confirmed. Absolute gamma intensities and β^- branching ratios are measured for the decay of Ho^{166} and a decay scheme is presented. (auth)

12496 EXCITED STATES OF URANIUM-233. Georg Schultze and Juergen Ahlf (Institut für Experimentalphysik, Hamburg). Nuclear Phys., 30: 163-76(Feb. 1962). (In German)

The conversion electrons in the decay of Pa^{233} are investigated for energies above 8 kev using a wedge-shaped magnetic spectrometer, the resolution being 0.15% at the higher energies. The multipolarities, spins, and parities of five levels and the decay probabilities of the gamma-transitions in U^{233} are derived. Two new levels are found at 95.90 and near 20 kev. A deviation of the M-shell M1-conversion coefficients from the theoretical values is found, which is caused by screening effects. (auth)

12497 THE TOTAL CROSS SECTION OF ALUMINIUM FOR NEUTRONS OF ENERGIES FROM 0.003 ev TO 0.009 ev. D. Bally, S. Todireanu, and S. Rîpeanu (Inst. of Atomic Physics, Bucharest). Nuclear Sci. and Eng., 12: 157-9(Feb. 1962).

The dependence of the total neutron cross section of crystalline and liquid aluminum was studied for energies between 0.003 and 0.009 ev. The results obtained for crystalline aluminum show that in the case of absence of texture they are in fair agreement with the calculated values. The study of liquid aluminum shows that the scattering cross section determined by subtraction of the calculated absorption cross section from the measured total cross section, in the studied range, decreases with increasing wavelength. (auth)

12498 NEUTRON CAPTURE TO FISSION RATIOS IN U^{233}, U^{235}, Pu^{239}. J. C. Hopkins and B. C. Diven (Los Alamos Scientific Lab., N. Mex.). Nuclear Sci. and Eng., 12: 169-77(Feb. 1962).

The ratio of neutron capture to fission cross sections, α, was measured for U^{233}, U^{235}, and Pu^{239} at 9 incident neutron energies from 30 to 1000 kev. A pulsed and collimated neutron beam is passed through a target placed at the center of a large, cadmium-loaded, liquid scintillator. Capture and fission events are detected by means of their prompt gamma rays; elastic and inelastic scattering events are discarded because of their smaller pulse height. Fission is identified by the delayed pulses produced by capture in the scintillator of the fission neutrons. Corrections are applied for the fission events not followed by delayed neutron pulses and for the effect of background counts. This procedure yields values of $1 + \alpha$ to an accuracy of 1 or 2%. (auth)

12499 TOTAL NEUTRON CROSS SECTION OF Pa^{231}. F. B. Simpson (Phillips Petroleum Co., Idaho Falls, Idaho), W. H. Burgus, J. E. Evans, and H. W. Kirby. Nuclear Sci. and Eng., 12: 243-9(Feb. 1962).

The total cross section for Pa^{231} was measured from 0.01 ev to 2 kev, with the use of the Materials Testing Reactor fast chopper with resolutions from 0.040 to 2.0 μsec/meter. The Breit-Wigner resonance parameters were obtained for the resonances below 11.0 ev. These measurements were made with samples prepared from 0.558 g of Pa_2O_5. Weighting the level spacings inversely as $2f + 1$ gives the average observed level spacings per spin state of 0.72 and 1.2 ev. This is one of the smallest spacings observed in any isotope. The average parameters give a value of 0.63×10^{-4} for the s-wave neutron strength function Γ_n^0/D. A linear least squares fit to the data between 0.015 and 0.03 ev gives a value of 211 ± 2 barns for the thermal cross section. The resonance absorption integral (for neutrons with energies >0.1 ev) is 1560 ± 55 barns, with a contribution of approximately 65% from the 0.396 ev resonance. (auth)

12500 EFFECTIVE RESONANCE INTEGRAL OF THORIUM METAL. Alan B. Rothman and Charles E. W. Ward (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 12: 293-300(Feb. 1962).

A new measurement of the effective resonance integral of thorium metal was made, using reactor oscillator techniques. Fluctuations in reactor power level, caused by oscillation of cadmium-shielded cylindrical samples, were recorded on a strip chart. The signal was Fourier-analyzed, and the coefficient of the fundamental mode determined. For a constant shape reactivity input, the value of this coefficient for each sample is proportional to the effective resonance integral of the sample. The scattering effects of the thorium were determined by oscillating identical samples of lead, and were deducted from the results for the thorium. Absolute calibration of the oscillator measurements was provided by oscillating several dilute solutions of each of three standard absorbers: boron, indium, and gold. The effective resonance integrals of the thorium cylinders were then found to be given by the formula: $I_{eff} = (-0.2 \pm 1.3) + (17.2 \pm 2.1)\sqrt{S/M}$ barns, where S/M is the surface-to-mass ratio of the samples in cm^2/g. The 1/v component of the resonance integral, 3.6 barns, was removed from the first term of this formula. (auth)

12501 DETERMINATION OF ETA BY COMPARISON OF $\overline{\eta\sigma}$ FOR U^{233} AND Pu^{239} WITH $\overline{\eta\sigma a}$ FOR U^{235} IN A FLUX TRAP CRITICAL ASSEMBLY. R. Gwin and D. W. Magnuson (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 12: 359-63(Mar. 1962).

The values of eta for U^{233} and Pu^{239} were determined by a reactivity coefficient measurement. An aqueous solution of each isotope was introduced axially into a critical cylindrical annular flux trap reactor, and the resulting reactivity change was measured by period determinations. From these data the ratios $[\overline{\eta\sigma}(U^{233})/\overline{\eta\sigma}(U^{235})]$ and $[\overline{\eta\sigma}(Pu^{239})/\overline{\eta\sigma}(U^{235})]$ were obtained. Using measured values of eta for U^{235} and the absorption cross sections in this ratio, the thermal values of 2.317 ± 0.040 for eta of U^{233} and 2.032 ± 0.053 for eta of Pu^{239} were obtained. Correction to a neutron velocity of 2200 meters/sec by using the appropriate g-factor gives a value of 2.317 ± 0.040 for eta of U^{233} and 2.082 ± 0.054 for eta of Pu^{239}. (auth)

12502 RULES OF EXISTENCE AND CLASSIFICATION OF ISOTOPES. Jean Hély. Nucleus (Paris), No. 5, 333-8(Sept.-Oct. 1961). (In French)

The rules of existence for stable isotopes and the classification of natural nuclei for the first 82 elements—hydrogen to lead—are derived. It is shown that for the 280 isotopes there are only 30 anomalies to the rules that nuclei with an odd number of protons are unstable and that elements with odd Z possess only one stable isotope. These anomalies are discussed, and methods for eliminating them are given. It is seen that the Mendeleev classification of the

elements differs from the natural isotopes of these elements only by the replacement of some of the isotopes with isobars of Z immediately adjacent. (J.S.R.)

12503 NUCLEAR RESONANCE FLUORESCENCE IN SOLID ^{60}Co SOURCES. M. Giannini, D. Prosperi, and S. Sciuti (Centro di Studi Nucleari della Casaccia, Rome and Università, Rome). Nuovo cimento (10), 22: 1197-1205(Dec. 16, 1961). (In English)

Compensation required for restoring resonant conditions can be performed by means of the motion that the emitting nucleus might have as the result of one or more preceding transitions. Nuclear resonance cross sections in Co^{60} solid sources exhibit strong dependence from the mean life of the second excited level of Ni^{60}, from which start the 1.17-Mev γ rays involved in the compensation. A model in which attenuation is related to mean life is described. Analyzing experimental results obtained using a solid Co^{60} source, the second level mean life turns out to be $\leq 5 \times 10^{-12}$ sec. This procedure seems to allow mean life estimates concerning a level leading, through a cascade, to the ground state, any time a situation similar to the $Co^{60} \rightarrow Ni^{60}$ decay occurs. (auth)

12504 MONTE CARLO CALCULATIONS ON INTERACTIONS OF 300 MeV PROTONS WITH CARBON. E. Abate, G. Bellini, E. Fiorini, and S. Ratti (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Nuovo cimento (10), 22: 1206-36(Dec. 16, 1961). (In English)

Monte Carlo calculations on interactions of 300-Mev protons with carbon nuclei were performed using a Remington Rand Univac U.T.C. electronic computer. Nuclear cascades of collisions on bound nucleons were studied. The same calculations were then repeated with the assumption that each cascade nucleon has a non-zero probability (30 and 40%) of colliding with an α-cluster instantaneously formed inside the nucleus. The treatment of the cascade was carried out with the assumptions of a Fermi and of a gaussian distribution of nucleon momenta inside the nucleus. Results obtained were the percentages of cascades as functions of the number of collisions and of the number and nature of fast secondaries, the angular and energy distributions of the fast secondaries, and the excitation-energy distributions of the residual nuclei. The comparison of the results of the calculations with the few available experimental data gives the best agreement if the hypothesis of the existence of clusters inside the nucleus is adopted. The assumption that the momentum distribution of the nucleons is gaussian leads to absurd results concerning the energy spectrum of fast secondary nucleons and the spectrum of excitation energies of the residual nuclei. If a Fermi momentum distribution is assumed, the calculated spectra are reasonable and in agreement with experimental data. (auth)

12505 STATISTICAL EMISSION IN NUCLEAR REACTIONS AND NUCLEAR LEVEL DENSITY. E. Erba (Università, Milan), U. Facchini, and E. Saetta Menichella. Nuovo cimento (10), 22: 1237-60(Dec. 16, 1961). (In English)

An attempt is made to show the possibility of explaining a certain group of nuclear reactions with a statistical model. The experiments discussed refer to resonance measurements for slow neutrons; energy spectra of particles emitted in the reactions (n,p), (n,n'), and (p,n) for incident energies ranging between 4 and 16 Mev; and cross sections of (n,p) and (n,n') at 14 Mev. From the experiments discussed, it is possible to obtain a consistent table of the a parameter in the nuclear level density formula. (auth)

12506 SCATTERING OF HIGH-ENERGY NUCLEONS BY HEAVIER NUCLEI. T. Takemiya and Y. Sakamoto (Kyoto Univ.). Nuovo cimento (10), 22: 1284-6(Dec. 16, 1961). (In English)

Observed differential cross sections are given by products of certain factors and differential cross sections calculated using the impulse approximation. The factors do not depend on the scattering angles at forward small angles. Effective nuclear potentials for target nuclei are introduced. As the incident energy increases, the mean free path and effective energy grow larger. Effects of pair correlation are considered. (L.N.N.)

12507 TOTAL INELASTIC CROSS-SECTION FOR NEGATIVE PIONS AND PROTONS IN Cu, Cd, AND Pb AT HIGH ENERGIES. R. N. Peacock, B. Hahn, E. Hugentobler, and F. Steinrisser (Université, Fribourg, Switzerland). Nuovo cimento (10), 22: 1290-2(Dec. 16, 1961). (In English)

Total inelastic cross sections for π^- reactions at 6 to 17.6 Bev/c and for proton reactions at 24 Bev/c were measured. Absorbers were Cu, Cd, and Pb. A bubble-chamber arrangement was used, enabling identification of absorption processes. Data are presented in tabular form. (L.N.N.)

12508 ENERGY-DEPENDENCE OF FRAGMENTATION PARAMETERS. D. E. Evans and R. R. Hillier (Bristol Univ., Eng.). Nuovo cimento (10), 22: 1300-2(Dec. 16, 1961). (In English)

Differential prong distributions of stars produced in nuclear emulsions by protons at 0.4 to 27 Bev were measured, and integral prong distributions were constructed. Results may be applied to cosmic-nuclei fragmentation studies. Data are presented in graphical form. (L.N.N.)

12509 THE GAMMA RADIATION FROM Po^{212}(ThC'). F. C. Flack and J. E. Johnson (Univ. of Exeter, Eng.). Proc. Phys. Soc. (London), 79: 10-13(Jan. 1, 1962).

Decay of Bi^{212} to Po^{212} was studied by coincidence techniques, and gamma radiations emitted from Po^{212} were distinguished from other gamma rays in the thorium decay series. An estimate of intensities enabled the assignment of multipole orders to some transitions. The branching ratio of Bi^{212} and the half-life of the ground state of Po^{212} were re-measured. (auth)

12510 GAMMA RAY ANGULAR CORRELATION IN THE INELASTIC SCATTERING OF MEDIUM ENERGY PROTONS FROM THE FIRST EXCITED STATE OF C^{12}. G. L. Salmon, A. B. Clegg, K. J. Foley, P. S. Fisher, and D. J. Rowe (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 79: 14-26(Jan. 1, 1962).

Measurements are reported of the polarization of the first excited state of C^{12} produced by inelastic scattering of 150-Mev protons through several angles, the polarization being indicated by the angular correlation of the decay gamma rays. Results are analyzed to obtain information about the details of the inelastic scattering interaction. Much the same nuclear wave-functions are involved in this medium-energy proton reaction as in low-energy reactions. (auth)

12511 THE Li^7(p,p') REACTION AT 150 MEV. D. Newton, A. B. Clegg, G. L. Salmon, P. S. Fisher, and K. J. Foley (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 79: 27-33(Jan. 1, 1962).

Measurements of proton inelastic scattering at 150 Mev from the first excited state of Li^7 are reported. Results are compared with other measurements of inelastic scattering from higher states of Li^7 and support the identifica-

tion of the low-lying negative parity states of Li^7 as a rotational band in a distorted nucleus. Measurements of the outgoing proton polarization from inelastic scattering of medium energy protons from 1p-shell nuclei give further support to the identification of rotational bands in these nuclei. (auth)

12512 THE LOW ENERGY SCATTERING OF POSITRONS BY HYDROGEN ATOMS. B. H. Bransden (CERN, Geneva). Proc. Phys. Soc. (London), 79: 190-5 (Jan. 1, 1962).

The effect of the real or virtual formation of positronium on the low energy elastic scattering of positrons by hydrogen atoms is estimated by a perturbation method, in which that part of the scattering due to the static field of the hydrogen atom is automatically allowed for. Numerical results indicate that the positron is attracted to the atom at low energies, and that virtual formation positronium is extremely important. (auth)

12513 AN INVESTIGATION OF THE $^{29}Si(p,\gamma)^{30}P$ REACTION. E. E. Baart, L. L. Green, and J. C. Willmott (Univ. of Liverpool). Proc. Phys. Soc., (London), 79: 237-56 (Feb. 1, 1962).

The $Si^{29}(p,\gamma)P^{30}$ reaction was studied at six resonances below 1 Mev. From analysis of the results obtained, spin and parity assignment were made to six of the low lying levels, and tentative assignments to four more levels. It is shown that these results do not readily fit in with what is expected on the Nilsson model. (auth)

12514 OPTICAL MODEL ANALYSIS OF THE ELASTIC SCATTERING OF LOW ENERGY DEUTERONS. R. N. Maddison (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 79: 264-73 (Feb. 1, 1962).

Experimental cross sections of the elastic scattering of 1- to 20-Mev deuterons by nuclei were analyzed using the optical model without spin-orbit forces. Two methods of predicting parameter values were studied; the least squares method, with some modifications, was found more satisfactory. In most cases it is possible to obtain satisfactory agreement between theory and experiment, and trends in the parameters are shown. (auth)

12515 THE ISOMER IN ^{119}Sn AND THE QUADRUPOLE MOMENT OF THE FIRST EXCITED STATE. A. J. F. Boyle, D. St. P. Bunbury, and C. Edwards (The University, Manchester, Eng.). Proc. Phys. Soc. (London), 79: 416-24 (Feb. 1, 1962).

Using the Mössbauer effect, the nuclear quadrupole splitting of the first excited state of Sn^{119} was measured in tin compounds, and a comparison was made of isomer shifts of the ground state transition. The isomer shift is interpreted in terms of a change in the mean square deformation of the nucleus $\langle\beta^2\rangle$ arising mainly from the zero-point vibrational motion. The difference in $\langle\beta^2\rangle$ between the excited and ground states is $+6 \times 10^{-4}$. From estimates of the field gradient at the Sn^{119} nucleus, a value of about -8×10^{-24} cm^2 was assigned to the quadrupole moment of the $3/2^+$ state. Values of the two measured quantities are calculated using a model of a single particle coupled to a vibrator. The inclusion of pairing correlations of the nuclear force is necessary to obtain agreement with experimental results. (auth)

12516 PARTIAL EQUILIBRIUM MODEL FOR NUCLEAR REACTIONS. Ko Izumo (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 26: 807-28 (Dec. 1961). (In English)

A new model for nuclear reactions is proposed in order to investigate the "intermediate resonances" detected experimentally in the intermediate energy region. The basic assumption is that only several nucleons of the target nucleus are excited at the compound system. Calculations are made in terms of the concept of the partial-equilibrium-compound-nucleus and the direct interaction. Numerical results for the level distances of the "intermediate resonances" agree with experiment. The number of excited nucleons in the compound system is about six and depends slightly on the excitation energy or the mass number of target nucleus (in this energy region). Further it is shown that outgoing channels couple with each other to form a gross channel corresponding to the "intermediate level" of the residual nucleus. The average distances between the gross channels are about 300 kev. (auth)

12517 NUCLEAR RADIATION FROM SOLIDS. Tetsuo Eguchi (Kyushu Univ., Fukuoka). Progr. Theoret. Phys. (Kyoto), 26: 900-16 (Dec. 1961). (In English)

An operator identity concerning the Hamiltonian of a harmonic oscillator enables calculations of the distribution of the energy of nuclear radiation from solids, which includes the effect of multiple phonon processes exactly. The moments of the recoil energy or of the energy of radiation are obtained to any order in terms of the moments of the frequency of lattice vibration. These relations suggest a method of experimental determination of the frequency distribution of lattice vibration. (auth)

12518 NATURE OF THE FIRST EXCITED STATES OF THE VIBRATIONAL EVEN-EVEN NUCLEI. Taro Tamura and Takeshi Udagawa (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 26: 947-66 (Dec. 1961). (In English)

The energy of the first excited states of even-even nuclei, and the probability of the electromagnetic transition between this and the ground states are calculated. The calculation covers almost all the known vibrational even-even nuclei, and is performed by assuming that the effective interaction is a sum of the pair and Q-Q interactions, and by employing the Bardeen-Cooper-Schrieffer and Sawada approximations. The agreement of the obtained results with experiments are in general good, although it becomes poor for cases which have a smaller number of nucleon outside closed shells. For such cases rigorous shell model calculation is also performed and comparing the results with the approximate ones, discussions on the validity of those approximations are made. (auth)

12519 IMAGINARY PART OF THE OPTICAL POTENTIAL FOR NUCLEI A ~60 AND A ~100. Atsushi Sugie (Japan Atomic Energy Research Inst., Tokyo), Kichinosuke Harada, and Hisashi Horie. Progr. Theoret. Phys. (Kyoto), 26: 1010-11 (Dec. 1961). (In English)

The imaginary part of the optical potential, which shows shell effect, is estimated for Fe^{56} and Cd^{112}. The expectation value is $\Sigma_{jj'j''} G^2V^2I^2 \times [W^2/(E_{\frac{1}{2}} + E_j - E_{j'} - E_{j''})^2 + W^2]$ n_j, where E_j, etc., are single particle energies with pairing energy of state j, etc.; n_j is the number of particles in state j; V is the strength of the nuclear force; and I is the orbital overlap integral. For Cd, W is about $1/3$ the value for Fe. (L.N.N.)

12520 PRODUCTION OF Te^{127} IN HIGH-ENERGY PROTON BOMBARDMENT OF I-127. M. Ya. Kuznetsova, Nam-puk Ming, V. N. Rybakov, and V. A. Khalkin. Radiokhimiya, 3: 755-9 (1961). (In Russian)

A radiochemical analysis was made of Te^{127} production in I^{127} bombardment by 120 to 660-Mev protons. It is postulated that the reaction $I^{127}(p,p\pi^+)Te^{127}$ is responsible for the high yield of Te^{127} at 160 to 260 Mev. (R.V.J.)

12521 THE ENERGY OF ATOMIC NUCLEUS. Francisco Torio. Rev. geofís. (Madrid), 20: 111-23 (Apr.-June). (In Spanish)

The way in which an atomic nucleus, whether stable or radioactive, acts is explained by using a spacial representation which assimilates the loss of energy to a descent and the gain of it to an ascent. A simplified demonstration is then given of the Weizsacker formula for the energy of the nucleus. (auth)

12522 RESONANCE ENERGIES FOR PROTON CAPTURE. III. PHOSPHORUS AND CHLORINE. M. Heitzmann and S. Wagner (Physikalisch-Technische Bundesanstalt, Brunswick and Berlin). Z. Naturforsch., 16a: 1136-8 (Nov. 1961). (In German)

The following resonance energies (in kev) were determined in a high voltage stabilized cascade accelerator: $P^{31}(p,\gamma)S^{32}$: 354.6 ± 0.4, 439.1 ± 0.5, 541.1 ± 0.6, and 642.0 ± 0.7; $Cl^{35}(p,\gamma)Ar^{36}$: 444.1 ± 0.5, 532.9 ± 0.6, 575.2 ± 0.6, 643.2 ± 0.7, and 656.0 ± 0.7; and $Cl^{37}(p,\gamma)Ar^{38}$: 426.9 ± 0.5, 503.5 ± 0.6, 600.5 ± 0.6, 624.2 ± 0.7, and 690.1 ± 0.7. The resonance energies were determined from measurements of the acceleration voltage relative to a potentiometer, which could be calibrated with the help of the $Al^{27}(p,\gamma)Si^{28}$ reaction resonances at 504.6 ± 0.3 and 506.6 ± 0.3. The assignment to both chlorine isotopes was made with the help of collectors in which each of the isotopes was enriched. Upper limits between 100 and 300 ev could be determined for the total half-value width of these resonances. (tr-auth)

12523 CONTRIBUTIONS OF MULTIQUANTUM EXCHANGE TERMS TO THE COULOMB CORRECTOR IN THE RATIO OF THE TOTAL (e,N) TO THE TOTAL (γ,N) CROSS SECTION. Rudolf Rodenberg (Universität, Tübingen, Ger.). Z. Naturforsch., 16a: 1242-3(Nov. 1961). (In German)

The ratio of the total (e,N) to the total (γ,N) cross section in the Born approximation for electric and dipole transitions was derived in an earlier work (Z. Phys., 158: 44(1960)) in the first non-vanishing approximation of the S matrix formalism. In the present article the contribution of higher approximations to the individual development terms of the Coulomb corrector in each perturbation theory approximation was derived. (J.S.R.)

12524 NOTE ON THE INTRODUCTION OF FORM FACTORS IN THE THEORY OF (e,N)-PROCESSES. Rudolf Rodenberg (Universität, Tübingen, Ger.). Z. Naturforsch., 16a: 1243-4(Nov. 1961). (In English)

It is shown that the general interaction Hamiltonian and the general expression for the matrix elements for the (e,N) process derived earlier (Z. Phys., 158: 44(1960) and Z. Phys., 162: 347(1961)) in the first non-vanishing order of the S matrix formalism can be used to derive the inelastic electron-nuclei scattering cross section in the generalized Rosenbluth formula. (J.S.R.)

12525 THE SYMMETRICAL BEHAVIOR OF THE EFFECTS OF FINITE EXPANDED NUCLEI IN THE TRANSITION FROM (e,N) TO ($\bar{e}$,N) PROCESSES. Rudolf Rodenberg (Universität, Tübingen, Ger.). Z. Naturforsch., 16a: 1244-5(Nov. 1961). (In German)

By means of a model suitable for inelastic electron or positron scattering on atomic nuclei, the complete symmetry of the effect of the finite expanded nucleus in the transition from particle to antiparticle is shown. (J.S.R.)

12526 THREE-ALPHA DECAY OF C^{12*} (16.11 MEV). D. Dehnhard, D. Kamke, and P. Kramer (Universität, Marburg, Ger.). Z. Naturforsch., 16a: 1245-6(Nov. 1961). (In German)

The α spectrum and the p-α-α coincidence spectrum of the nuclear reaction $B^{11}(p,\alpha)$ was studied. Within the resonance at E_p = 163 kev, the coincidence spectrum cannot be ascribed to the cascade decay of C^{12*} by the Be^{8*} 2.9 Mev level. The assumption of a simultaneous decay into three alpha particles yields a simple explanation of the results by the Delves and Smith theory. It is emphasized that the triple decay results from a sharp level of the compound nucleus C^{12*}(16.11 Mev). (J.S.R.)

12527 THE DECAY OF MERCURY-194. E. Merz (Kernforschungsanlage, Jülich, Ger.). Z. Naturforsch., 16a: 1246-7(Nov. 1961). (In German)

The decay scheme of Hg^{194} was investigated, and the half life was measured. The half life value obtained was 146 ± 6 days. Since no annihilation radiation could be observed in the γ spectrum of pure Hg^{194}, it was assumed that the decay is exclusively from the ground state by electron capture directly to the ground state of Au^{194}. The limits for a positron decay is ≤1%. (J.S.R.)

12528 ANGULAR CORRELATION MEASUREMENTS OF Hf^{180} AND DETERMINATION OF THE g_R FACTOR OF THE 2^+ AND THE 4^+ ROTATION LEVELS. E. Bodenstedt, H. J. Koerner, E. Gerdau, J. Radeloff, C. Guenther, and G. Strube (Physikalische Staatsinstitut, Hamburg). Z. Physik, 165: 57-71(1961). (In German)

The following angular correlations in the decay of Hf^{180m} were measured: for the 215 kev−93 kev γ-γ cascade, $W(\Theta) = 1 + (0.093 \pm 0.007)P_2 + (0.014 \pm 0.009)P_4$; for the 332 kev−215 kev γ-γ cascade, $W(\Theta) = 1 + (0.090 \pm 0.010)P_2 + (0.006 \pm 0.010)P_4$; and for the 501 kev−332 kev γ-γ cascade, $W(\Theta) = 1 + (0.004 \pm 0.007)P_2 - (0.002 \pm 0.012)P_4$. Liquid sources of HfF_4 dissolved in concentrated HF were used for these experiments. The angular correlation of the 215 kev−93 kev cascade was found to be slightly attenuated by internal fields. A measurement of the differential angular correlation for different delays gave $\lambda_2 = (0.073 \pm 0.036) \times 10^9$ sec^{-1} assuming $A_2(t) = A_2(0) \times e^{-\lambda_2 t}$. The above correlation functions agree with the interpretation of the low lying states of Hf^{180} as a $(0^+, 2^+, 4^+, 6^+)$ rotational band. The 501 kev−332 kev angular correlation shows that the multipolarity of the 501 kev γ transition is a mixture of (3.5 ± 0.5)% M2 and (96.5 ± 0.5)% E3. The rotation of angular correlations in a strong external magnetic field was observed and the gyromagnetic ratios of the 2^+ and the 4^+ rotational states were determined as $g_R(2^+ \text{ level}) = +0.371 \pm 0.032$ and $g_R(4^+ \text{ level}) = +0.5 \pm 0.1$. (auth)

12529 SUPER-PERMITTED POSITRON DECAY OF K^{38m}, Sc^{42}, AND Ti^{43}. J. Jaenecke and H. Jung (Max-Planck-Institut für Kernphysik, Heidelberg). Z. Physik, 165: 94-8(1961). (In German)

The maximum energies and the half lives of three short-lived β^+ activities near A = 40 were measured with a scintillation detector. The maximum β^+ energies of 5.00 ± 0.07 Mev (K^{38m}), 5.32 ± 0.10 Mev (Sc^{42}), and 5.81 ± 0.15 Mev (Ti^{43}) are in agreement with the predictions of a semiempirical formula. (auth)

12530 PRODUCTION OF 21 NEW SHORT-LIVED ISOMERS BY PHOTONUCLEAR REACTIONS. H. Krehbiel and U. Meyer-Berkhout (Universität, Heidelberg). Z. Physik, 165: 99-120(1961). (In German)

Irradiation of 28 selected elements with 22.5 Mev bremsstrahlung led to the production of numerous short-lived isomeric states by photonuclear reactions. At least 21 of the observed isomeric transitions seem not to have been reported in the literature thus far. The energies and half-lives of the observed transitions were measured using a conventional scintillation spectrometer. The half-lives of the newly discovered isomeric states are in the region be-

tween 5×10^{-6} and 6×10^{-2} seconds. Isotopic assignments and multipolarities of the observed transitions have not yet been established. (auth)

12531 THE NUCLEAR MOMENTS AND THE RELATIVE ISOTOPE SHIFT OF Os^{187}. G. Guthoehrlein, H. Kopfermann, G. Noeldeke, and A. Steudel (Universität, Heidelberg). Z. Physik, 165: 356-68(1961). (In German)

Using 4 mg of radiogenic Os^{187} the hyperfine structure of this isotope was investigated with a recording Fabry-Perot interferometer. From the measurement of intensities and distances of the hyperfine-structure components in three fine-structure lines, the spin and the magnetic moment were determined to be $I = \frac{1}{2}$ and $\mu_I = +(0.0652 \pm 0.0011)$ nm. In three fine-structure lines the isotopic shift was measured and the relative isotopic shift of Os^{187} was found to be $\Delta\nu(Os^{192} - Os^{187})/\Delta\nu(Os^{192} - Os^{190}) = 3.09 \pm 0.03$. The two classifications of the fine-structure line λ 4261 Å were verified by observing both transitions in Os^{187}. (auth)

12532 THE COEFFICIENTS OF THE INTERNAL PAIR FORMATION IN THE γ TRANSITIONS $Co^{60} \rightarrow Ni^{60}$ AND $Pr^{142} \rightarrow Nd^{142}$. H. Langhoff, P. Kilian, and A. Flammersfeld (Universität, Göttingen, Ger.). Z. Physik, 165: 387-92(1961). (In German)

The coefficients ϵ of internal pair formation of the 1.17 and 1.33 Mev transitions in Ni^{60} and of the 1.57 Mev transition in Nd^{142} were measured by detecting the annihilation radiation of the positrons. The values $\epsilon = (3.7 \pm 0.6) \times 10^{-5}$ for Ni^{60} and $\epsilon = (10.8 \pm 1.8) \times 10^{-5}$ for Nd^{142} were obtained. The results for Ni^{60} are in good agreement with theoretical calculations. The 1.57 Mev transition in Nd^{142} is identified as electric quadrupole and the first excited level of Nd^{142} is determined to be 2^+. By further measurements the partial transition from Pr^{142} to the first excited level of Nd^{142} was found to be $(3.7 \pm 0.4)\%$ per disintegration. No K capture of Pr^{142} more than 2×10^{-4} could be detected. (auth)

12533 RELATIVE MEASUREMENT OF THE INTEGRATED EFFECTIVE CROSS SECTION FOR THE PHOTONUCLEAR EFFECT: THE REACTION $O^{16}(\gamma,n)O^{15}$. P. Brix, H. Fuchs, K. H. Lindenberger, and C. Salander (Universität, Heidelberg). Z. Physik, 165: 485-90(1961). (In German)

Li_2CO_3 and $Na_2C_4H_8O_8$ were irradiated by 34-Mev bremsstrahlung. The yield of the induced O^{15} activity was measured relative to the yield of the $C^{12}(\gamma,n)C^{11}$ or $Cu^{63}(\gamma,n)Cu^{62}$ reaction by detecting the annihilation quanta. Additional yield measurements with the bremsstrahlung beam attenuated by 18 mm of lead were made to determine the ratio of the integrated cross sections for the reactions $O^{16}(\gamma,n)O^{15}$ and $C^{12}(\gamma,n)C^{11}$ on $Cu^{63}(\gamma,n)Cu^{62}$. Using the cross section of Barber et al. for $C^{12}(\gamma,n)C^{11}$, the cross section integrated up to 33 Mev for $O^{16}(\gamma,n)O^{15}$ was obtained as 61 ± 7 Mev mb. (auth)

12534 AN ESTIMATION OF CONTRIBUTION TO THE NUCLEAR POLARIZATION IN MESIC ATOMS FROM A NON-SPHERICAL SYMMETRIC MESON STATE. W. Greiner and H. Marschall (Universität, Freiburg i. B.). Z. Physik, 165: 171-5(1961). (In German)

The muon found in a non-spherical symmetrical state of a mesic atom causes a deformation of the nuclear surface. The polarization produced by the meson contains therefore a fraction which is limited by an induced quadrupole moment. This fraction is estimated. An energy displacement of about 4 kev is found for the Pb nucleus, which is spherically symmetric in the absence of the muon. (tr-auth)

12535 ON FORBIDDEN E1 TRANSITIONS IN Tb^{159} AND Yb^{173}. G. A. Vartapetyan, Z. A. Petrosyan, and A. G. Khudaverdyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1704-9(Dec. 1961). (In Russian)

Measurements are made on the half life for the 364-kev level in Tb^{159}, $T_{1/2} = -(1.7 \pm 0.7) \times 10^{-10}$ sec, and for the 351-kev level in Yb^{173}, $T_{1/2} = (4.2 \pm 0.7) \times 10^{-10}$ sec. The probabilities for E1 transitions are calculated and compared with the values computed from the Nilsson model. It is concluded that, just as in case of Hf^{177}, an E1 transition occurs with a transition probability that is evidently different from the theoretical value. (auth)

12536 THE LIFETIME AND NATURE OF THE 686-kev LEVEL IN Re^{187}. G. A. Vartapetyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1710-12(Dec. 1961). (In Russian)

The half life of the 686-kev level in Re^{187} is measured by the delayed coincidence method and found to be $(2 \pm 0.7) \times 10^{-10}$ sec. The corresponding E1 and E2 transition probabilities are compared with those calculated by the Nilsson model. The 686-kev level is not necessarily a vibrational level. (auth)

12537 ELASTIC SCATTERING OF-247 Mev γ-QUANTA ON HYDROGEN. P. S. Baranov, L. I. Slovokhotov, G. A. Sokol, and L. N. Shtarkov (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 1713-21(Dec. 1961). (In Russian)

The angular distribution of 247 ± 10-Mev γ quanta elastically scattered by hydrogen is investigated. Differential cross sections are obtained for γ scattering angles of 148, 132, 108, 93, 70, and 55° in the c.m.s. The experimental results are compared with calculations based on one-dimensional dispersion relations, in which the additional contribution from the single-meson-intermediate state is taken into account. (auth)

12538 α-DECAY OF Pu^{239}. B. S. Dzhelepov, R. B. Ivanov, and V. G. Nedovesov (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1725-8(Dec. 1961). (In Russian)

The α spectrum of Pu^{239} is measured with a double-focusing magnetic α spectrograph. Transitions to the excited levels of the U^{235} nucleus are detected at 104, 198, 224, and 299 kev. A possible interpretation of the U^{235} levels is discussed. A Pu^{239} decay scheme is presented. (auth)

12539 A NEW ISOTOPE Er^{159}. A. A. Abdurazakov, F. M. Adburazakova, K. Ya. Gromov, and G. Ya. Umarov (Joint Inst. for Nuclear Research, Dubna, USSR and Tashkent Polytechnical Inst., [USSR]). Zhur. Eksptl'. i Teoret. Fiz., 41: 1729-32(Dec. 1961). (In Russian)

The spectrum of conversion electrons produced in the decay of neutron-deficient erbium isotopes is measured with a constant magnetic field β-spectrograph. A new erbium isotope with a mass number 159 ($T_{1/2} = \sim 1$ hour) is discovered. Some γ transitions that arise in the decay chain $Er^{159} \rightarrow Ho^{159} \rightarrow Dy^{159}$ are detected. A decay scheme for this chain is proposed. (auth)

12540 INVESTIGATION OF RADIOACTIVE DECAY OF Np^{237}. S. A. Baranov, V. M. Kulakov, P. S. Samoilov, A. G. Zelenkov, and Yu. F. Rodionov. Zhur. Eksptl'. i Teoret. Fiz., 41: 1733-9(Dec. 1961). (In Russian)

The radioactive decay of Np^{237} is investigated. More than 20 fine structure monoenergetic α groups are established by analyzing the α spectrum of Np^{237}. On the basis of the experimental data obtained with help of β and γ spectrometers it is possible to detect twelve γ transitions in the Pa^{233} nucleus. An energy level scheme for the Pa^{233} nucleus is constructed from the data obtained. (auth)

12541 ENERGY LEVELS OF THE U^{232} NUCLEUS. S. A. Baranov, P. S. Samoilov, Yu. F. Rodionov, S. N. Belen'kii, and S. V. Pirozhkov. Zhur. Eksptl'. i Teoret. Fiz., 41: 1740-7(Dec. 1961). (In Russian)

Radioactive decay of Pa^{232} is studied with a double focussing magnetic β spectrometer and a scintillation γ spectrometer. An energy level scheme for the U^{232} nucleus is derived by analyzing the β spectrum, conversion electron spectrum, and γ spectrum. The scheme agrees with the level schemes of other even deformed nuclei. The existence of E0 transitions between the levels $0_2^+ \rightarrow 0_1^+$ and $2_2^+ \rightarrow 2_1^+$ is established. The experimental data are compared with the predictions of the Bohr–Mottelson theory and the theory of nonaxial deformed even nuclei. (auth)

12542 SCATTERING OF 8.5 Bev PROTONS ON PROTONS. Ying-seb To, L. F. Kirillova, P. K. Markov, L. G. Popova, I. N. Silin, E. N. Tsyganov, M. G. Shafranova, B. A. Shakhbazyan, and A. A. Yuldashev (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1748-56(Dec. 1961). (In Russian)

Elastic pp scattering at 8.5 Bev is studied with aid of photographic emulsions, the primary proton beam being perpendicular to the emulsion plane. Altogether 480 elastic scattering events are found. The total elastic scattering cross section is (8.74 ± 0.40) mb. The differential cross section is investigated in the angle range from 1.5 to 20.5° in the c.m.s. The experimental data are not found to agree with the simple model in which the real part of the phase shifts and the dependence of the interaction cross section on the spin state are neglected. The total pp interaction cross section computed from the experimental data under these assumptions exceed the experimental value by an amount equal to three times the error. It can be asserted that the real part of the scattering amplitude does not exceed half of the imaginary part. The mean square pp interaction range is found to be 1.15 ± 0.05 fermi. (auth)

12543 INVESTIGATION OF THE REACTION $C^{12}(\alpha,4\alpha)$. S. S. Vasil'ev, V. V. Komarov, and A. M. Popova. Zhur. Eksptl'. i Teoret. Fiz., 41: 1757-60(Dec. 1961). (In Russian)

The disintegration of the C^{12} nucleus into three α particles under the action of 23-Mev α particles is investigated. Space and energy distributions of the disintegration products and also the excitation energies of possible C^{12} and Be^8 intermediate nuclei are given. It is found that the main mechanism of the investigated reaction is decay of the O^{16} nucleus into four α particles with resonance interaction between the α particles in the ground state. (auth)

12544 LEVELS OF THE Si^{30} NUCLEUS FROM THE REACTION $Si^{29}(d,p)Si^{30}$. K. I. Zherebtsova, V. F. Litvin, Chao-yuen Liu, and Yu. A. Nemilov (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1761-2(Dec. 1961). (In Russian)

Data on the 8.149- and 8.571-Mev levels in Si^{30} are obtained by measuring with a multispectrograph the energy and angular distributions of protons emitted in the $Si^{29}(d,p)$ reaction. (auth)

12545 ISOMER ENERGY SHIFTS OF THE 23.8 Kev γ-TRANSITION IN THE Sn^{119} NUCLEUS. V. S. Shpinel, V. A. Bryukhanov, and N. N. Delyagin (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1767-70(Dec. 1961). (In Russian)

The isomer shifts for the 23.8-kev γ-transition in Sn^{119} in various chemical compounds containing tin are determined by measuring the resonance absorption of γ quanta by nuclei in crystals. A possible qualitative interpretation of the observed shifts is discussed. It is suggested that the variation of the effective proton distribution radius in the nucleus takes place upon excitation of the Sn^{119} nucleus, and that the proton core of the Sn^{119} nucleus in the excited state does not have a spherically symmetric shape. (auth)

12546 INVESTIGATION OF THE α-RADIOACTIVITY OF A NATURAL PLATINUM. K. A. Petrzhak and M. I. Yakunin (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1780-2(Dec. 1961). (In Russian)

The α radiation of platinum with natural isotopic composition is measured with an ionization chamber with a grid. Precise values of the α particle energy and half life of Pt^{190} are obtained. It is suggested that some new α lines may be present in the observed spectrum. (auth)

12547 DETERMINATION OF THE SIGN OF THE LOCAL MAGNETIC FIELD ON NUCLEI OF GOLD DISSOLVED IN IRON AND NICKEL. B. N. Samoilov, V. V. Sklyarevskii, and V. D. Gorobchenko. Zhur. Eksptl'. i Teoret. Fiz., 41: 1783-6(Dec. 1961). (In Russian)

The signs of the local magnetic field on gold nuclei are determined from the asymmetry of the β radiation emitted from polarized Au^{198} nuclei in weak solutions of gold in iron and nickel. The most probable values of the fields are $H_n = -1.0 \cdot 10^6$ gauss for gold in iron and $-1.8 \cdot 10^5$ gauss in nickel. (auth)

12548 INVESTIGATION OF THE $\pi^- + n \rightarrow \pi^- + n + m\pi^0$ REACTION WITH A 2.8 Bev/c π^--MESON BEAM. Yu. D. Bayukov, G. A. Leksin, Ya. Ya. Shalamov (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1787-92(Dec. 1961). (In Russian)

Production of mesons in the reaction $\pi^- + n \rightarrow \pi^- + n + m\pi^0$ is investigated, using a freon bubble chamber. The momentum of the incident meson is 2.8 Bev/c. The results obtained are compared with the statistical theory and the peripheral interaction model. (auth)

12549 PHOTOPRODUCTION OF π^0-MESONS ON DEUTERIUM AT ENERGIES FROM 170 TO 210 Mev. A. S. Belousov, S. V. Rusakov, E. I. Tamm, and L. S. Tatarinskaya (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 1793-1803(Dec. 1961). (In Russian)

The ratio of the π^0 meson photoproduction cross sections on deuterium and hydrogen is measured for energies between 170 and 210 Mev. The measurements are performed for meson emission angles of 44, 84, and 124° in the laboratory system. The experimental data are compared with the impulse approximation theory. (auth)

12550 OBSERVATION OF THE REACTION $\mu^- + He^3 \rightarrow H^3 + \nu$. O. A. Zaimidoroga, M. M. Kulyukin, B. Pontecorvo, R. M. Sulyaev, A. I. Filippov, V. M. Tsupko-Sitnikov, and Yu. A. Shcherbakov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1804-8 (Dec. 1961). (In Russian)

A diffusion chamber filled with He^3 is used to observe the $\mu^- + He^3 \rightarrow H^3 + \nu$ reaction. The upper limit of the mass m_ν of the neutral particle emitted in the capture of muons by nucleons ($m_\nu < 6$ Mev) was determined by measuring the recoil energy of H^3. Preliminary data indicate that the probability of this reaction is $(1.30 \pm 0.40) \times 10^3$ sec^{-1}, which is consistent with the value predicted by the universal theory of weak interactions. (auth)

12551 INVESTIGATION OF THE ENERGY DEPENDENCE OF THE CROSS SECTION FOR PHOTOPRODUC-

TION OF π^+-MESONS ON HYDROGEN NEAR THE THRESHOLD. M. I. Adamovich, E. G. Gorzhevskaya, V. G. Larionova, N. M. Panova, V. M. Popova, S. P. Kharlamov, and F. R. Yagudina (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 1811-17(Dec. 1961). (In Russian)

The differential cross sections for photoproduction of positive pions on hydrogen are measured in the photon energy range from 167 to 212 Mev. The measurements are carried out at an angle $\theta = \cos^{-1}(k\omega - 0.93)/kq$ (the angle for which the contribution of the nonphysical region to the dispersion integrals is zero). The results are in agreement with the dispersion theory. A detailed analysis of the experimental results is carried out together with data on the angular distribution. (auth)

12552 A COVARIANT DEDUCTION OF THE WEIZSACKER–WILLIAMS FORMULA. V. N. Gribov, V. A. Kolkunov, L. B. Okun, and V. M. Shekhter. Zhur. Eksptl'. i Teoret. Fiz., 41: 1839-41(Dec. 1961). (In Russian)

A simple and explicit covariant deduction of the Weizsacker–Williams formula is presented. (auth)

12553 COULOMB AND NUCLEAR INTERACTIONS IN DEUTERON STRIPPING REACTIONS. V. G. Sukharevskii and I. B. Teplov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1842-4(Dec. 1961). (In Russian)

The differential cross sections for the reaction $Si^{30}(d,p)Si^{31}$ are calculated by taking into account coulomb and nuclear interactions. These interactions do not appreciably affect the ratio of the cross sections in the angular distribution peaks for various states of the final nucleus ($l = 0$ and $l = 2$). (auth)

12554 COMMENT ON THE PROBLEM OF THREE-PARTICLES WITH POINT INTERACTION. R. A. Minlos and L. D. Faddeev (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1850-1(Dec. 1961). (In Russian)

An integral equation for the wave function of three particles interacting in a point-like manner is considered. It is demonstrated that the discrete spectrum of this equation is infinite and extends to $-\infty$. (auth)

12555 SPACING OF NUCLEAR ENERGY SURFACES. V. A. Kravtsov (Leningrad Polytechnic Inst.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1852-8(Dec. 1961). (In Russian)

A study of the distances between nuclear energy levels derived from experimental data reveals that the mean distances decrease approximately as $A^{-\frac{1}{3}}$. It is confirmed that on the average the distance between an even-even surface and an odd-A surface is greater than the distance between an odd-odd surface and an odd-A surface. These mean distances are given by an empirical formula. The distances between the surfaces are found to grow for magic numbers and on the boundaries of deformed nuclei regions. (auth)

12556 A PLAUSIBLE MODEL OF Λ-PARTICLE PRODUCTION IN HIGH ENERGY πN-COLLISION. Jung Wang and Shih-K'o Hu (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1868-9(Dec. 1961). (In Russian)

A simple model of Λ particle production in high energy πN collisions is considered. The polarization and the distribution of transverse momentum of Λ particles, and the percentage of the particles which are emitted forward in the c.m.s., are calculated. It is shown that the model is in agreement with experimental data. (auth)

12557 INELASTIC INTERACTION OF 660 Mev PROTONS WITH CARBON NUCLEI. A. P. Zhdanov and P. I. Fedotov (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1870-8(Dec. 1961). (In Russian)

The applicability of the Serber–Goldenberg model for calculation of intranuclear cascades on light nuclei is considered. Some features of light nuclei which may significantly affect the calculations are discussed. The following factors are taken into account in the calculation of a cascade in a carbon nucleus: collisions of nucleons with α-type substructures; variation of the density of nuclear matter from the center of the nucleus to its periphery; momentum distribution of nucleons in light nuclei; and processes involving meson production. Comparison of calculations and experimental data yields agreement. (auth)

12558 CREATION OF π-MESONS IN WEAK INTERACTIONS. Ya. I. Azimov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1879-84(Dec. 1961). (In Russian)

Meson production processes caused by interaction of a neutrino or antineutrino with a nucleon are considered. Numerical estimations of the cross sections are made on the basis of data on electron production. (auth)

12559 GIANT RESONANCE IN Pb^{208} PHOTODISINTEGRATION. V. V. Balashov, V. G. Shevchenko, and N. P. Yudin (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1929-33(Dec. 1961). (In Russian)

The cross section for dipole absorption of quanta by Pb^{208} nuclei is calculated according to the shell model. It is shown that if residual pair interactions between nucleons are taken into account the "giant resonance" energy approximately doubles. The calculations are in agreement with the experiments. (auth)

12560 RELATIVISTIC CORRECTIONS TO THE MAGNETIC MOMENTS OF H^3 AND He^3. N. S. Zelenskaya and Yu. M. Shirokov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1934-7(Dec. 1961). (In Russian)

A general expression is derived for the relativistic corrections to the nuclear magnetic moment arising as a result of non-Galilean relativistic corrections to the nucleon-nucleon interaction Hamiltonian. Corrections to the H^3 and He^3 magnetic momenta are computed numerically. The correction terms have the right sign and order of magnitude but explain not more than 30% of the existing discrepancy between theory and experiment. (auth)

12561 IONIZATION OF HYDROGEN ATOMS BY ELECTRONS WITH ACCOUNT OF INTERFERENCE. R. K. Peterkop (Inst. of Physics, Academy of Sciences, Latvian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1938-9(Dec. 1961). (In Russian)

The cross section for ionization of the hydrogen atom by electrons is calculated in the Born approximation, taking into account interference effects. (auth)

12562 AMBIGUITY IN THE DETERMINATION OF THE INTERPOLATING FIELD. D. A. Slavnov and A. D. Sukhanov (Moscow State Univ. and Inst. of Mathematics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1940-8(Dec. 1961). (In Russian)

The ambiguity in determination of the interpolating field is considered. The connection of this nonuniqueness with that involved in the determination of the T-product for a given S-matrix and also with the nonuniqueness in the determination of the S-matrix outside the energy surface is established. The possibility of going over from one of these interpretations to the other is discussed. (auth)

12563 ISOTOPIC STRUCTURE OF WEAK INTERACTIONS AND PROCESSES DURING THE ABSORPTION OF NEUTRINOS OR ANTINEUTRINOS BY NUCLEONS. V. M. Shekhter (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1953-61(Dec. 1961). (In Russian)

Some of the processes of absorption of neutrinos or antineutrinos (ν or $\bar{\nu}$) by nucleons should lead to the formation of a system of baryons and mesons with a zero total strangeness. It is suggested that the weak interactions responsible for such processes are local, CP-invariant, and include a baryon-meson current that is an isotopic vector component. The relation between the cross sections of similar reactions during the absorption of a ν or $\bar{\nu}$ respectively is indicated, and a method for qualitatively distinguishing V, A and S, P, T weak interaction variants is indicated. Isotopic equalities between the amplitudes of various absorption processes of ν or $\bar{\nu}$ by nucleons are written down. (auth)

12564 PARTIAL WAVES WITH COMPLEX ORBITAL MOMENTA AND THE ASYMPTOTIC BEHAVIOR OF THE SCATTERING AMPLITUDE. V. N. Gribov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1962-70(Dec. 1961). (In Russian)

It is shown that in relativistic theory the partial wave amplitudes f_l are analytical functions of the angular momentum l. The asymptotic behavior of the scattering amplitude as a function of the transferred momentum is determined by the nearest singularities of f_l. An expression for the scattering amplitude at arbitrary transferred momenta is obtained in terms of f_l satisfying the Mandelstam equation, which relates the spectral functions and the absorption terms. The behavior of the scattering amplitude at high energies is discussed. (auth)

12565 ON THE COUPLING CONSTANTS IN μ-CAPTURE. L. D. Blokhintsev and E. I. Dolinskii (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1986-95(Dec. 1961). (In Russian)

It is shown that within the framework of the universal Fermi interaction theory, quite good agreement with experimental data on interactions between μ mesons and nucleons can be attained in the theory in which the vector current is conserved and the effective pseudoscalar coupling constant $g_p^{(\mu)}$ is large. In agreement with the theory the ratio $g_p^{(\mu)}/g_A^{(\mu)}$ is found to be positive. (auth)

12566 INTERACTION OF γ-QUANTA WITH ORIENTED NONSPHERICAL NUCLEI. S. F. Semenko and B. A. Tulupov (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 1996-2001(Dec. 1961). (In Russian)

An analysis of experimental possibilities for observation of optical anisotropy effects is presented. The influence of the accuracy of scattered proton energy measurements and of the degree of nuclear orientation on these effects is studied. Some consequences of possible nonaxiality of nuclei are discussed. (auth)

12567 ON THE N. V. PLESHIVTSEV ARTICLE ON "COPPER SPUTTERING BY HYDROGEN IONS AT 50 Kev." Yu. V. Bulgakov (Karpov Inst. of Physics and Chemistry, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 2015-16(Dec. 1961). (In Russian)

According to the Pleshivtsev data the following ions were present in the beam: H^+ (30 to 40%), H_2^+ (40 to 50%), and H_3^+ (30 to 10%), O_2^+ and N_2^+ (1 to 3%). An attempt is made to show that the sputtering coefficient $S_{observ.}$ in the Pleshivtsev data on the copper sputtering by hydrogen ions at 10 kev to 10 Mev differ from the true S_{H^+} coefficient of hydrogen ion sputtering. The analysis of copper sputtering by high-energy hydrogen ions shows that the observed coefficient growth with ion energies cannot be attributed to the effect of high-energy protons until the data on beam monochromaticity is established. (R.V.J.)

12568 EXCITATION FUNCTIONS FOR (γ,d) AND (γ,p) REACTIONS ON B^{10} AND Be^9 NUCLEI. Yu. M. Volkov, A. V. Kulikov, and V. P. Chizhov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 42: 61-4(Jan. 1962). (In Russian)

Excitation functions for (γ,d) and (γ,p) reactions on B^{10} and Be^9 nuclei are presented. The (γ,d) cross section is shown to have a considerable magnitude only for γ energies exceeding the reaction threshold by a value approximately equal to the binding energy of the nucleon in the residual nucleus. (auth)

12569 ANGULAR ANISOTROPY AND ENERGY DISTRIBUTION OF Th^{232} FISSION FRAGMENTS. B. C. Kuz'minov, L. S. Kutsaeva, and I. I. Bondarenko. Zhur. Eksptl'. i Teoret. Fiz., 42: 105-7(Jan. 1962). (In Russian)

Results of measurement of the kinetic energy of the fragments and angular anisotropy as a function of the fragment mass ratio are presented. The kinetic energy is found to have a maximum for a mass ratio R = 1.25. Within experimental errors the angular anisotropy is independent of the mass ratio. (auth)

12570 PHOTONUCLEAR REACTIONS INVOLVING THE EMISSION OF DEUTERONS AND TRITONS WITH ENERGIES BELOW 15 Mev. Yu. M. Volkov and L. A. Kul'chitskii (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 42: 108-14(Jan. 1962). (In Russian)

The cross sections per effective quantum were obtained for (γ,p), (γ,d), and (γ,t) on Li^6 and Li^7. The relative yields $Y(\gamma,d)/Y(\gamma,p)$ and $Y(\gamma,t)/Y(\gamma,p)$ for Li^6, Li^7, B^{11}, and Cu as a function of energy E_{max} were measured. Angular distributions of photoprotons, photodeuterons, and phototritons for Li^7 and the excitation function for $Li^7(\gamma,t)$ are presented. It is shown that photodeuterons are predominantly produced in reactions in which one or several particles are emitted in addition to deuterons. The measurements of the excitation function for $Li^7(\gamma,t)$ and of triton angular distribution agree with the concept of direct dipole absorption of γ quanta by the Li^7 nucleus as a $t + \alpha$ system. (auth)

12571 THE MOSSBAUER EFFECT ON TUNGSTEN ISOTOPES. O. I. Sumbaev, A. I. Smirnov, and V. S. Zykov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 42: 115-23(Jan. 1962). (In Russian)

The dependence of nonrecoil nuclear resonance absorption at the W^{182} 100.09 kev and W^{183} 99.07 kev and 46.48 kev levels on the relative velocity between the source and absorber is investigated. The measurements were made by separating the resonance line with a scintillation counter and by using a focusing crystal diffraction γ spectrometer with a resolving power of several tenths of a percent. The source (tantalum) and absorber (tungsten) Debye temperatures were 280^{+30}_{-10} and 320^{+70}_{-40}° respectively. The observed effect was not smaller than the theoretical value. Total widths of the indicated levels were measured. The width of the 100.09 kev level agrees with that derived by the Coulomb excitation method and by delayed coincidences but is not consistent with the result of a previous experiment on nuclear resonance absorption in W^{182}. The experimental values of the widths are in good agreement with theoretical values. (auth)

12572 ON SYMMETRY OF NUCLEAR FISSION. V. P. Eismont. Zhur. Eksptl'. i Teoret. Fiz., 42: 178-9(Jan. 1962). (In Russian)

Asymmetry of fission fragment masses is observed only in nuclei which possess an appreciable number of nucleons outside closed shells with Z = 82 and N = 126. It is suggested that external nucleons caused instability of the fissioning nucleus with respect to asymmetric deformations. The postulation is shown to agree with experimental data. (auth)

12573 NUCLEAR SHELLS AND PROMPT FISSION NEUTRONS. M. V. Blinov and V. P. Eismont. Zhur. Eksptl'. i Teoret. Fiz., 42: 180-2(Jan. 1962). (In Russian)

An explanation is offered for some features of recently discovered prompt neutron emission. The explanation is based on closed nuclear shell effects on the fragment shape before fission. (auth)

12574 A POSSIBLE EXPLANATION OF THE VARIATION OF THE DIFFERENTIAL CROSS SECTION FOR THE REACTIONS (p,α) AND (α,p) IN THE LARGE ANGLE REGION. I. B. Teplov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 211-16(Jan. 1962). (In Russian)

In order to explain the peaks in the differential cross section of (p,α) and (α,p) in the large angle region, a direct process with local interaction is proposed, that is, a process in which the impinging particle interacts with a small part of the initial nucleus. An approximate calculation of the angular distributions for this process is performed for $F^{19}(p,\alpha)O^{16}$. (auth)

12575 DIRECT NUCLEAR PHOTOEFFECT AND THE OPTICAL MODEL OF THE NUCLEUS. Yu. V. Orlov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 247-52(Jan. 1962). (In Russian)

Shell models with γ-γ coupling were used for developing simple formulas in the dipole approximation for the cross section and polarization in a direct nonresonance photonuclear effect. Interactions in the final state are described by a complex optical model potential. Numerical calculations were performed for a rectangular potential well. The roles of various interaction details were analyzed. (auth)

12576 RELATION BETWEEN THE COLLECTIVE AND SHELL DESCRIPTIONS OF DIPOLE EXCITATIONS OF ATOMIC NUCLEI. V. V. Balashov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 275-81(Jan. 1962). (In Russian)

A model based on a shell interpretation of collective dipole excitation of nuclei is proposed for calculating the position and width of gigantic resonances and the total photoabsorption cross section. The model also yields a qualitative explanation of the relation between different photoabsorptions and the energy spectra of photoproducts. Photodisintegration of C^{12}, O^{16}, Ca^{40}, and Pb^{208} are calculated. (auth)

12577 INELASTIC PHOTON SCATTERING IN THE COULOMB FIELD OF A NUCLEUS. S. S. Sannikov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 282-5(Jan. 1962). (In Russian)

Disintegration of a high energy photon into two photons in the Coulomb field of a nucleus is studied by the dispersion relation method. Expressions for differential cross sections of split small energy photons are determined. (auth)

12578 ON THE LOW NEGATIVE PARITY LEVELS IN NON-SPHERICAL NUCLEI. D. B. Zaretskii and M. G. Urin (Moscow Inst. of Engineering Physics). Zhur. Eksptl'. i Teoret. Fiz., 42: 304-6(Jan. 1962). (In Russian)

A superfluid model is suggested for interpreting the 1^- level. An octupole-octupole interaction was introduced into the Hamiltonian system in addition to the pair interaction. The latter is similar to the quadrupole-quadrupole interaction used in describing quadrupole-type collective excitations in spherical and non-spherical nuclei. The second quantization approximation was used for developing the excitation energy equation ($\hbar = 1$). (R.V.J.)

Particle Accelerators

Refer also to abstract 11864

12579 (HEPL-249) PRODUCTION OF POSITRONS WITH THE STANFORD MARK III ACCELERATOR. D. Yount and J. Pine (Stanford Univ., Calif. High-Energy Physics Lab.). [1961]. Contract [AT(04-3)-326]. 17p.

A positron beam of intensity of 7×10^6 positrons per pulse (60 pulses per second) was obtained with the Stanford electron linac. The energy is 300 Mev and the energy spread is 2%. The method of production of the beam and the factors involved in maximizing the intensity are discussed. (auth)

12580 (JINR-P-849) METHODY IZMENENIYA DLITEL'NOSTI VZAIMODEISTVIYA PUCHKA S MISHEN' YU V SINKHROFAZOTRONE NA 10 BEV. (Methods for Measuring Interactions Between a Beam and a Target in 10 Bev Synchrophasotron). G. S. Kazanskii, A. I. Mikhailov, K. P. Myznikov, and A. P. Tsarenkov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 17p.

Methods are given for changing the timing and duration of the beam-target interaction in a synchrophasotron. Techniques that allow several targets to be used in the same acceleration cycle are described. (auth)

12581 (JINR-P-852) SINKHRONIZATSIYA RABOTY PUZYR'KOVOI KAMERY S SINKHROTSIKLOTRONOM. (Synchronized Operation of a Bubble Chamber with Synchrocyclotron). M. P. Balandin, V. G. Grebinnik, and G. I. Selivanov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 12p.

A design of the synchronizing system for matching the operation of the bubble chamber with that of the synchrocyclotron is described, and its main technical characteristics are given. The necessary stability of this system is achieved by means of the coincidence circuit which is connected with a light pulse generator. The design of the device allows the intervals between different starting pulses to be varied independently. (auth)

12582 (JINR-P-855) FOKUSIROVKA I YUSTIROVKA PUCHKA INZHEKTORA LINEINOGO USKORITELYA. (Focusing and Adjusting Linear Accelerator Injector Beam). Yu. N. Antonov, L. P. Zinov'ev, I. V. Kozhukhov, V. P. Rashevskii, V. P. Sarantsev, and Chung-mu Chang (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 19p.

The focusing and alignment of an injector beam in a linear synchrophasotron accelerator is described. The distance between the ion source and the resonator pipe is 5000 mm. The beam diameter at the accelerator entrance is ≤ 5 mm and the angular divergence is $\leq 3 \times 10^{-3}$ rad with a proton pulse current of 50 to 70 ma (pulse time = 450 μsec at a proton energy of 570 kev). The design of the device is included. (R.V.J.)

12583 (NIRL/R/2) BASIC CONCEPTS IN THE DESIGN OF ELECTROSTATIC VELOCITY SEPARATORS. N. Marshall King (Gt. Brit. National Inst. for Research in Nu-

clear Science. Rutherford High Energy Lab., Harwell, Berks, England). Nov. 1960. 50p.

Properties and limitations of an isolated parallel-plate crossed-field single-stage velocity separator were examined. The design objective was taken to be optimization of wanted-particle transmission through the separator in the plane of separation. In relation to certain acceptance and separation criteria, a treatment of beam behavior in phase space was developed, leading to a suitable optimization procedure. For given particles at given momentum, separator length was recommended in terms of the voltage and separator aperture; it was suggested that both these latter parameters should be as large as possible, consistent with practical limitations. Two types of beam contour, parallel and focused, were considered and compared. Two cases are discussed: first, where the wanted-particles are stable; second, where they are subject to decay. Wanted-particle decay is a major consideration in determining optimum lengths. These cases are exemplified by particular treatment of ($\bar{P}$, π^-) and (K^-, π^-) separation, and appropriate data were derived at various momenta. It is emphasized that the ($\bar{P}$, π^-) data are closer to practical specification than that for ($\bar{K}$, π^-). Basic assumptions of the theory were critically reviewed, and a future theoretical program is suggested. (auth)

12584 (NIRL/R/5) FERRITE FOR THE ACCELERATING CAVITY OF NIMROD, ITS ELECTRICAL PROPERTIES AND THEIR MEASUREMENTS. D. J. Thompson (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England). Feb. 1961. 25p.

The electrical properties specified for the ferrite for the accelerating cavity of Nimrod are quoted. Methods of measuring these properties are described for small test toroids and large cavity frames. Results of such measurements are given and different grades of ferrite compared. (auth)

12585 (NIRL/R/6) DESIGN OF FRINGING SHIMS FOR MAGNET POLES. J. J. Wilkins and A. H. Spurway (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England). May 1961. 33p.

Dimensions of fringing shims for uniform-field magnets were computed using two-dimensional (conformal transformation) theory. Tables and graphs of design data are given for single shims and for shim-antishim combinations, appropriate to various required degrees of uniformity of field and field-gradient. The computations were restricted to very simple pole and shim geometries, but methods of extrapolation to more refined geometries are indicated. Application of the data to still more general magnet designs, e.g. quadrupole magnets, is also discussed. (auth)

12586 (TID-14385) ANNUAL PROGRESS REPORT FOR PERIOD DECEMBER 1960 THROUGH NOVEMBER 1961 [ON LINEAR ACCELERATOR]. (Minnesota. Univ., Minneapolis. Linear Accelerator Lab.). Nov. 1961. Contract AT(11-1)-50. 131p.

Results of experimental and theoretical research on the Minn. proton linear accelerator are summarized. Included are data and reports concerning accelerator performance, improvements, new equipment, and new techniques developed during the period. The information is presented in sections on accelerator progress, experimental program, experimental instrumentation, and theoretical programs. (J.R.D.)

12587 (UCRL-9981) BEVATRON OPERATION AND DEVELOPMENT. XXX. [Period Covered], May–July 1961. Walter D. Hartsough (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 2, 1962. Contract W-7405-Eng-48. 9p.

During this quarter the Bevatron operated 83% of the scheduled operating time. The machine was off 15% of the scheduled operating time because of component failure and 2% at the request of the user. A total of 1947 hours of experimental time was accumulated by groups engaged in primary experiments. Eighteen target bombardments were made. (auth)

12588 A NON-INTERCEPTING ACCELERATOR BEAM POSITION SENSOR. K. Johnson, T. Klippert, and W. J. Ramler (Argonne National Lab., Ill.). Nuclear Instr. & Methods, 14: 125-30(Dec. 1961). (In English)

A nonintercepting beam position sensor consisting of two sets of pick-up coils, resonant-tuned, is used with a differential amplifier and an oscilloscope to determine the spatial position of a pulsed beam from an electron linear accelerator. A pulsed beam of 100 ma peak can be positioned to about 0.5 mm. The feasibility of using this position sensor technique with an external cyclotron beam is discussed. The design, method of construction, and performance of the linac sensor are discussed. A summary of the cyclotron sensor is given. (auth)

12589 A BEAM PROFILE INDICATOR FOR USE WITH HIGH ENERGY PARTICLE ACCELERATORS. G. Manning and A. C. Sherwood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 14: 182-8(Dec. 1961). (In English)

The equipment described enables the rate of high-energy particles passing through a 5"-by-5" array of plastic scintillators to be displayed directly as an analog pattern on the screen of an oscilloscope. The pattern is a 10-by-10 array of 100 spots on the cathode ray tube, the intensity of the spots representing the particle intensity through the corresponding ½"-by-½" element of the detector. Provision is also made for the direct storage of the counts from the 100 elements in the memory of a suitable 100-channel pulse height analyzer. The unit can be gated with an external counter enabling some other criterion to be demanded of the particles recorded. Tests indicate that it is possible to use this unit to display directly and record the profile of beams of high energy particles in the intensity range of 1 to $\sim 10^6$ per second. (auth)

12590 ISOTOPE PRODUCTION WITH THE NUFFIELD 60-INCH CYCLOTRON. PART 1. K. F. Chackett, G. A. Chackett, and W. B. Hardy (Univ. of Birmingham, Eng.). Nuclear Instr. & Methods, 14: 215-18(Dec. 1961). (In English)

The bombardment conditions and target techniques used for isotope production with the cyclotron are described. Some estimates of isotope production yields are given. (auth)

12591 ISOTOPE PRODUCTION WITH THE NUFFIELD 60-INCH CYCLOTRON. PART 2. K. F. Chackett, G. A. Chackett, Bikram Singh, and G. B. Briscoe (Univ. of Birmingham, Eng.). Nuclear Instr. & Methods, 14: 219-21(Dec. 1961). (In English)

A machine is developed for handling "internal" targets from the cyclotron by remote control in a lead-shielded box. The machine can be used to shave active materials from metallic targets, and delivers the shavings into a standard isotope can, ready for transport. "External" targets of powdery non-metallic materials are handled in a shielded glove-box. (auth)

12592 PHASE STABILITY IN ACCELERATORS WITH ARBITRARY HIGH-FREQUENCY FIELD CONFIGURATION.

A. N. Lebedev (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 6: No. 6, 21-3(Nov.-Dec. 1961). (In Russian)

A general phase equation is developed for cyclic accelerators with arbitrary high-frequency field configurations and equilibrium orbits. It is shown that acceleration system modifications cannot change the damping of synchrotron oscillations, which are determined by the loss intensity relation to the particle energy. (tr-auth)

12593 THE ELECTRON OPTICS OF ELECTROSTATIC ACCELERATORS IN THE RELATIVISTIC RANGE. Joachim Kessler (Technische Hochschule, Karlsruhe, Ger.). Z. Naturforsch., 16a: 1138-46(Nov. 1961). (In German)

The properties of electrostatic lenses for relativistic particles are described by means of transfer matrices. Using Gans' polygon-method, the matrices are calculated by integrating the equation of motion of relativistic particles in electric fields that have rotational symmetry. These general results are used for calculating the first-order approximations of the characteristic data for two-cylinder lenses. Numerical evaluation shows that the lens properties at a fixed V_2/V_1 vary only slowly with increasing energy (V_1 and V_2 being the potentials of the lens). The results are compared with those calculated by Timm for the nonrelativistic case, which can be seen in our results as a special case. The easiest way of applying the derived formulas to the case of multistage accelerator tubes is discussed. (auth)

12594 H.-WAVE ACCELERATING SYSTEM. L. I. Bolotin, V. A. Bomko, E. I. Revutskii, I. S. Sidorenko. Zhur. Tekh. Fiz., 31: 1426-30(Dec. 1961). (In Russian)

A more effective cavity resonance accelerator using the H_{111} and H_{911} type waves is described. Experiments with a proton beam confirmed the theoretical calculations. From a geometric point of view the suggested resonator has certain advantages over the Berkeley type system. For the same charged particle energies, the length of an H_{111} wave resonator is about 1.4 folds smaller than the Berkeley, the resonator diameter is 4.5 times smaller. The system can be effectively applied in accelerating heavy ions (C, N, O, Ne, and etc.) with small initial energies ($\beta \approx 0.01$). (R.V.J.)

12595 THE COMPARISON OF IONIZATION AND CALORIMETER MEASURING OF ENERGY OF SYNCHROTRON BREMSSTRAHLUNG. [PART] II. S. P. Kruglov (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 31: 1451-61(Dec. 1961). (In Russian)

Inconsistencies observed in bremsstrahlung energy measurements made by transition curve and calorimetric methods are analyzed. It was found that for light elements these inconsistencies are related to radioactive losses of the absorber and the energy used in photonuclear reactions. For large-Z elements, errors result from incorrect evaluations of ionization losses by electron side scattering. The results of measurements made with a special extrapolation chamber, considering corrections for radiative and photonuclear reaction losses, are in good agreement with calorimetric data. (R.V.J.)

12596 METHODS OF DEVELOPING FOCUSING FIELDS. Ya. L. Geronimus (Khar'kov Aeronautic Inst.). Zhur. Tekh. Fiz., 32: 3-14(Jan. 1962). (In Russian)

Methods are suggested for developing focusing fields (all trajectories pass through the same field point after changing their initial rate) in which charged particles in a stationary external electromagnetic field are in motion from a given field point. Interactions between the particles are not considered, and focusing is analyzed from a purely geometric point of view. The studies are limited to motion in one plane. (R.V.J.)

12597 INDUKTSIONNYI USKORITEL ELEKTRONOV—BETATRON. (Induction Electron Accelerators—The Betatron). L. M. Anan'ev, A. A. Vorob'ev, and V. I. Gorbunov. Moscow, State Publishing House of Literature on Nuclear Science and Technology, 1961. 350p.

An analysis is made of betatron construction, optimum parameters, and physical processes. The electric scheme, electromagnet, vacuum system, and superstructure are calculated. Data are included on the construction and operation of cyclic accelerators and betatrons. (R.V.J.)

Plasma Physics and Thermonuclear Processes

12598 (AD-259741) ANALYSIS OF RESONANT CAVITY TECHNIQUES FOR MEASUREMENT OF EFFECTIVE ELECTRON DENSITY IN A PLASMA STREAM. Report No. 5-48. W. P. Cahill, W. C. Duesterhoeft and A. P. Deam (Texas. Univ. Austin. Electrical Engineering Research Lab.). June 30, 1961. Contract AF-33(616)-6257. 58p.

The feasibility is determined of using steady state electromagnetic cavity measurements to analyze transient decay characteristics of an ionized gas by causing a gas to flow through a glow discharge within a glass tube coaxial with a 400 mc cylindrical cavity. Measurements taken at different positions of the tube correspond to different times on the electron density decay curve. (auth)

12599 (AD-261661) THEORETICAL INVESTIGATIONS AND DESIGN STUDIES FOR THE EVENTUAL CONSTRUCTION OF A MEASURING DEVICE IN THE FIELD OF PLASMA ELECTRONICS. Monthly Technical Status Report No. 11, March 1—March 31, 1960. (Battelle Institut e. V., Frankfurt am Main). Apr. 30, 1960. 10p.

Work is reported on the design and construction of a ground receiver installation for determination of the angular error of electromagnetic waves passing through the ionosphere, the design of a satellite package to work with the above instrumentation using the swept frequency technique, and the design and construction of a laboratory device for measuring the properties of plasma at 10 cm by means of phase differences and amplitude comparisons of electromagnetic waves passing through the plasma. (auth)

12600 (AD-261663) THEORETICAL INVESTIGATIONS AND DESIGN STUDIES FOR THE EVENTUAL CONSTRUCTION OF A MEASURING DEVICE IN THE FIELD OF PLASMA ELECTRONICS. Monthly Technical Status Report No. 13, June 1 to June 30, 1960. (Battelle Institut e. V., Frankfurt am Main). July 31, 1960. Contract DA-91-591-EUC-1018. 11p.

A high-frequency apparatus is described for making phase measurements on plasmas. The apparatus uses the heterodyne heat method and gives the phase difference in terms of a d-c voltage. (D.L.C.)

12601 (AD-261665) THEORETICAL INVESTIGATIONS AND DESIGN STUDIES FOR THE EVENTUAL CONSTRUCTION OF A MEASURING DEVICE IN THE FIELD OF PLASMA ELECTRONICS. Monthly Technical Status Report No. 19, February 1—28, 1961. (Battelle Institut e. V., Frankfurt am Main). Mar. 30, 1961. Contract DA-91-591-EUC-1018. 13p.

Results of tests of a high-frequency apparatus for phase measurements by the heterodyne method are summarized.

Electron density distribution measurements for a large plasma container are reported. An automatic frequency control system is also described. In the cavity resonance method, graphs are given for the dependence of the amplitude of the first and second harmonics on the difference between the cavity resonance frequency and mean magnetron frequency and the dependence of the second harmonic on the frequency deviation/bandwidth ratio. (D.L.C.)

12602 (AD-261666) THEORETICAL INVESTIGATIONS AND DESIGN STUDIES FOR THE EVENTUAL CONSTRUCTION OF A MEASURING DEVICE IN THE FIELD OF PLASMA ELECTRONICS. Monthly Technical Status Report No. 20, March 1—March 31, 1961. (Battelle Institut e. V., Frankfurt am Main). Apr. 30, 1961. Contract DA-91-591-EUC-1018 OI-1165-59. 10p.

The design of receiving antennas for experiments on the angular deflection of electromagnetic waves of wavelength 3 and 10 cm is discussed. The band width B of the cavity resonator is plotted as a function of the relative amplitude A/A_1 of the 200 kc voltage, and the curves were found to touch the lines $B = (A/A_1)^{-0.5}$. Improvements in the plasma penetration unit (phase measurement by heterodyne method) are described. (D.L.C.)

12603 (AD-261667) THEORETICAL INVESTIGATIONS AND DESIGN STUDIES FOR THE EVENTUAL CONSTRUCTION OF A MEASURING DEVICE IN THE FIELD OF PLASMA ELECTRONICS. PART II. CORRECTION OF ANGULAR AND RANGE ERRORS. Monthly Technical Status Report No. 22, May 1—May 31, 1961. (Battelle Institut e. V., Frankfurt am Main). June 30, 1961. Contract DA-91-591-EUC-1081 OI-1165-59. 5p.

In experiments on angular deflection of 3-cm microwaves, a concentrated electromagnetic field was applied to a paraffin prism. The angle between the front and back sides of the prism was 11°, which led to partial reflection of the waves back to one side of the transmitting reflector. A paraffin prism with an angle of 25° will therefore be used to bring about total reflection and thus prevent return of the energy to the reflector. (D.L.C.)

12604 (AFCRL-62-240) STUDY OF SHOCK PROPAGATION IN A RAREFIED PLASMA, INTERACTION OF SHOCK WAVES WITH MAGNETIC FIELDS AND BASIC LAWS OF MAGNETO-GAS-DYNAMICS. Final Report. H. R. Griem (Maryland. Univ., College Park). Dec. 1961. Contract AF19(604)-4074. 28p.

Mach-20 to -70 shock waves are produced by capacitor discharges in preionized H_2 or He in T-shaped or cylindrical tubes. The equilibrium conditions behind the shock fronts, as well as the structure of the shock fronts, are studied in the T-shaped shock tubes. In the cylindrical tubes, one capacitor discharge preheats and preionizes the gas, and a second discharge magnetically compresses the plasma thus formed. (T.F.H.)

12605 (AFCRL-169) THE DOPPLER EFFECT IN DISPERSIVE, INHOMOGENEOUS MEDIA WITH APPLICATIONS TO ELECTROMAGNETIC WAVES IN IONIZED MEDIA. Research Report No. 10. O. E. H. Rydbeck (Chalmers Tekniska Högskola, Göteborg. Forskningslaboratorium för Elektronik). Mar. 1960. Contract AF 61(052)-159. 78p. (AD-258427)

The complex Doppler effect in dispersive, inhomogeneous media is studied with both geometrical optics and wave methods. The geometrical optics method is also extended to the case of a magneto-ionic medium. The isotropic ionosphere is used as an example of a resonant medium to derive simple interpretations of the Doppler modes, which can then be applied as good approximations to more complicated multi-resonant media. The focusing effect is also studied. (D.L.C.)

12606 (AFCRL-350) ELECTRODYNAMIC STUDY OF MAGNETIZED CURRENT CARRYING PLASMA. Final Report. G. H. Joshi (Sylvania Electronic Systems. Applied Research Lab., Waltham, Mass.). Apr. 14, 1961. Contract AF19(604)-7305. 101p. (AD-259096)

A linear macroscopic electrodynamic analysis of a fully ionized, collisionless, magnetized electron-ion drifting and/or stationary plasma was carried out. The analysis suggests two possible mechanisms which will convert the d-c energy of the drifting plasma to the electromagnetic energy and vice versa. The first mechanism involves the interactions between the circularly polarized transverse electromagnetic waves supported by an unbounded plasma which streams along the ambient magnetic field through an ambient stationary plasma. The other mechanism is based on the coupling between the quasi-transverse electromagnetic waves and the quasi-longitudinal space charge waves supported by a bounded plasma which drifts along the ambient magnetic field. This mechanism is restricted only at a frequency which is slightly below the ion cyclotron frequency. The two mechanisms might find an application in (a) the heating of the thermonuclear plasma and (b) plasma propulsion. The mechanism likewise might enable one to explain some of the low-frequency whistler type radio noise. Preliminary results are also presented on (a) the plasma waves in an inhomogeneous plasma and (b) the microscopic analysis of the drifting plasma. (auth)

12607 (AFCRL-566) STUDY OF MAGNETOHYDRODYNAMIC WAVES. Final Report. H. H. C. Chang (Hughes Research Labs. Div. of Hughes Aircraft Co., Malibu, Calif.). July 12, 1961. Contract AF19(604)-7372. 67p. (AD-262128)

The propagation of magnetohydrodynamic waves obliquely incident in a horizontally stratified ionosphere is discussed. The equations were cast in the coupled form suitable for computation by means of a high-speed modern computer, but no numerical results were obtained because of the prohibitive amount of work necessary to solve the equations in the case of oblique incidence and in the nongeometrical optics limit. (auth)

12608 (AROD-2262:4) PLASMA DIAGNOSTICS WITH VACUUM ULTRAVIOLET RADIATION. Final Report, October 30, 1958 to October 29, 1961. G. L. Weissler (University of Southern California, Los Angeles). Dec. 10, 1961. 42p.

An experimental survey was made on radiation in the wavelength range between 300 and 3000A emitted by hot plasmas, which were produced in Kolb-type shock tubes. While it could be demonstrated that such emission studies in the vacuum ultraviolet region of the spectrum are most certainly feasible, they require considerably more effort than those in the visible and quartz-ultraviolet, and they should therefore be restricted initially to such specific problems which require the investigation of a few emission lines of particular interest or of the intensity distribution of Bremsstrahlung continua. Specific absorption properties of hot plasmas as distinct from those cold gases were established. (auth)

12609 (AROD-2311:6) HYDROMAGNETIC STAGNATION-POINT FLOW FOR SMALL R_m. Technical Report No. 5, February 1, 1961—January 31, 1962. G. S. S. Ludford (Brown Univ., Providence and Cornell Univ., Ithaca, N. Y.). Jan. 1962. Contract DA-ORD-31-124-61-G34. 26p.

Hydromagnetic flow in the vicinity of a two-dimensional

stagnation point was considered, when the electrical conductivity is small and the applied magnetic field is at an arbitrary angle to the surface. First, inviscid flow was treated. Perturbation in the magnetic Reynolds number was singular; the previously found logarithmic singularity in vorticity at the surface of an arbitrary body was symptomatic of this fact. Then viscous effects were included, and it became evident that similarity solutions by no means tell the whole story. The principal functions are tabulated. (auth)

12610 (CAL-AF-1441-A-4) PLASMA STUDIES IN A SHOCK TUBE. John W. Daiber and Herbert S. Glick (Cornell Aeronautical Lab., Inc., Buffalo). July 1961. Contract AF30(602)-2267. 39p. (RADC-TN-61-130; AD-261517)

Air plasmas produced by shock waves were studied at temperatures from 3000 to 5000°K at densities from 0.005 to 0.015 times that of standard air. Microwave reflection measurements from these plasmas were made at frequencies of 3320 and 9375 Mc, in order to determine whether or not polarization forces on the electron are important. The results indicated that the theory in which the polarization forces are assumed to be negligible was proper for relating electron concentrations and cross sections with macroscopic electrical parameters. In addition, the collision frequencies of electrons in air were found. The data also provided an estimate of the relaxation time for electron formation. (auth)

12611 (D1-82-0127) INSTABILITY OF A WEAKLY IONIZED PLASMA IN A LONGITUDINAL MAGNETIC FIELD. Roy R. Johnson and David A. Jerde (Boeing Scientific Research Labs., Seattle). Dec. 1961. 58p.

The stability of a positive column in a longitudinal magnetic field is investigated by linearization of the macroscopic equations of motion and continuity for ions and electrons. The treatment is more general than similar calculations by Kadomtsev and Nedospasov and Glicksman, in that diffusion and magnetic field interaction terms are included in the ion equation of motion, and also in that the equations are solved in a rigorous manner without any a priori assumptions regarding the form of the radial dependence of the perturbations of density and potential. In the one example calculated, for the helical instability in helium gas, the important result is the existence of a finite perturbed potential at the wall radius, rather than a zero value as assumed by the above authors. The boundary between stability and instability as a function of longitudinal electric and magnetic fields is shown graphically, along with the wavelength and frequency of the helical mode at the critical value of the magnetic field. (auth)

12612 (NBS-7218) THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Eighth Progress Report, October 1, 1961 to December 31, 1961. (National Bureau of Standards, Boulder Labs., Boulder, Colo.). Dec. 31, 1961. 27p.

Research and development activities on the use of pulsed current techniques for studies of propagation in Nb wire and the resistive transition in Nb_3Sn wire are reported. Development of magnet technology is also reported in experiments with steady-state magnets, and in pulsed magnet power supply testing. Progress in refrigeration cycle analysis includes tabulation of thermodynamic properties of H gas and analysis of a small prototype refrigeration system. (J.R.D.)

12613 (NP-11383) A FIRST-ORDER MAGNETOHYDRODYNAMIC STOKES FLOW. Vivian O'Brien (John Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). June 1961. Contract NOrd-7386. 48p. (CM-997)

The first-order magnetohydrodynamic (MHD) flow of an incompressible conductive fluid about a small rigid sphere moving slowly in the direction of a uniform magnetic field was calculated. A perturbation stream-function was computed from the zero-order velocity and magnetic fields for use in evaluating the increase in drag due to the interaction between the two fields. The drag increase is proportional to the square of the Hartmann number and is a simple multiple of the Stokes drag value. Though the analysis is limited to very low Hartmann numbers, extension of the method to higher magnetic fields and to similar axisymmetric MHD problems is discussed. (auth)

12614 (NP-11414) ELECTROMAGNETIC WAVE PROPAGATION THROUGH A PLASMA: THEORETICAL AND EXPERIMENTAL STUDIES. George R. Evans, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Jan. 1962. 77p. (SB-61-56)

A bibliography on electromagnetic wave propagation through a plasma with special reference to the influence of a plasma on the propagation of microwaves is presented. The 173 references, with abstracts, are arranged alphabetically by author and cover the period from 1950 to Jan. 1962. A corporate author index is included. (M.C.G.)

12615 (NP-11433) MICROWAVE PROBING OF IONIZED GAS FLOWS. Technical Note No. 5. Robert G. Jahn (California Inst. of Tech., Pasadena. Guggenheim Jet Propulsion Center). Feb. 1962. Contract AF 49(638)-758. 34p.

The measurement of free electron densities and collision frequencies in ionized gas flows by a probing transverse microwave beam is described. Interpretation of the observed reflection and transmission coefficients and their phases was developed on the basis of an idealized plane wave–plane slab model, for which typical results are displayed. Application of the device and technique to a specific experiment, the build-up of ionization behind a strong shock in argon, is outlined. Effects of various departures of the microwave radiation patterns and flow configurations from the slab assumptions are discussed and examples evaluated. (auth)

12616 (PIBMRI-857-60) STUDY OF SURFACE WAVES ALONG THE BOUNDARY OF TWO COAXIAL CYLINDRICAL DIELECTRIC COLUMNS IN A CIRCULAR CYLINDRICAL METALLIC WAVEGUIDE WITH EXCITATION BY A MAGNETIC RING CURRENT. Surendra Nath Samaddar (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Oct. 7, 1960. Contract AF19(604)-4143. 61p. (AFCRL-79; AD-260045)

The field generated by a magnetic current ring in a waveguide of circular cross section partially filled with plasma was calculated. The waveguide was divided into two parts, one of which was filled with homogeneous plasma, the other being empty. The current was assumed to be independent of angle. The field was studied in the case of zero or infinite axial d-c magnetic field. (auth)

12617 (PIBMRI-932-61) THE ELECTROMAGNETIC FIELD OF A SOURCE-EXCITED PLASMA SLAB. Theodor Tamir (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Sept. 1961. Contract AF 19(604)-4143. 191p. (AFCRL-777)

The study of both the near and the far fields of a plasma slab in the presence of line sources revealed features that were hitherto unexpected in non-periodic, homogeneous and isotropic structures which do not support hybrid modes. The plasma slab was considered to be of finite thickness,

isotropic, and lossless, but of a dispersive nature; this medium could then be represented by a relative dielectric constant ϵ_p that can vary from unity to large negative values, depending on the frequency of excitation. Under the above conditions, it is shown that this structure may support one, two, or even three simultaneously-excited E-mode surface waves, provided the value of ϵ_p is sufficiently negative. The mechanism of power transfer is discussed. In addition, a discrete infinity of complex spectral E-modes was found for any negative value of ϵ_p. These complex waves are shown to appear in pairs which are coupled in such a manner that no net real power is transported; nevertheless, these complex waves may account for a large amount of stored energy in the near field. For positive values of ϵ_p in the case of E-modes, and for any ϵ_p in the case of H-modes, no surface waves are present and only improper leaky waves may exist which may strongly affect the shape of the radiation pattern. Solutions for the total field were found by means of the steepest descent method for excitation by line sources of either the electric or the magnetic current types; also, their location may be anywhere in the plasma or free-space region. It is then shown that for some locations of these sources both the surface and complex waves may be strongly excited; moreover, in some cases, the backward surface wave may be excited more strongly than the simultaneously-excited forward surface waves, so that the former should be detectable in a suitably designed experiment. The relative contribution to the near field of the various types of waves was compared with that of the space wave; it is shown that in the case of E-modes the space wave usually contributes less strongly in the near field than do the spectral or leaky waves, the reverse situation being true in the case of H-modes. The radiation field is discussed using three different approaches: the saddle point evaluation, the geometric optical method, and a Kirchhoff-Huygens integration technique. The results obtained by these various methods are in excellent agreement. The Kirchhoff-Huygens integration technique emphasizes the role of complex waves in determining the radiation pattern; for this reason, it offers an advantage over the other two methods for facilitating the location of peaks in the radiation pattern when the wavenumbers of the complex waves (of either the leaky or spectral type) are known. It is then shown that the leaky waves account for either a sharp radiation peak at an oblique angle or a broad peak at broadside, while the spectral complex waves account for a weak radiation at broadside only. The more practical case of a distributed source is also treated. It solution is shown to be obtainable directly from that for the line source; the expression for the radiation pattern is then given by the product of the line source solution and that for the source distribution in the absence of the plasma layer. (auth)

12618 (R61SD152) NON-LINEARIZED THEORY OF TRANSVERSE PLASMA OSCILLATIONS. Jacob Enoch (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Sept. 1961. Contract AF30(602)-1968. 36p.

Exact, nonlinearized solutions of the Vlasov equation are found for a homogeneous, neutral plasma with infinitely heavy ions in the presence of transverse electromagnetic waves. The dispersion relation is developed both for stationary waves and for the general initial value problem. It is proved that no growing wave solutions exist. A distribution function consistent with a single wave packet solution of the wave equation, which propagates subject to an arbitrary root of the dispersion relation, is constructed. The relationship between the initial electron distribution function and the dispersion relation is discussed. (auth)

12619 (TID-14953) EXPERIMENTAL INVESTIGATION OF CUSPED CONTAINMENT GEOMETRIES: CHALICE. Semi-annual Report, June 1, 1961 to December 1, 1961. George Yevick, Kenneth C. Rogers, and George Schmidt (Stevens Inst. of Tech., Hoboken, N. J.). Contract AT(30-1)-2582. 19p. (SIT-P56(1/62))

Qualitative studies are reported of the plasma behavior in CHALICE at low energies in the cusp region during preionization. Most of the results are obtained using only preheater (1μf) capacitors. Data are obtained using rotating mirror streak cameras, single Kerr cells, image converter framing cameras, and image converter streak cameras. (T.F.H.)

12620 (TID-15066) THE USE OF ATOMIC BEAMS AS A PROBE FOR STUDYING LOW DENSITY PLASMAS. B. Bederson, K. Rubin, H. H. Brown, Jr., K. Lulla, and P. Dittner (New York Univ., New York. Coll. of Engineering). [1962]. Contract AT(30-1)-2397. 23p.

Activities in a program concerned with the interaction of neutral beams with hot gases and plasmas are described. The work is primarily concerned with beam-gas interactions in the areas of atom-atom interactions in the thermal energy region, and beam-attenuation plasma temperature determination. Data obtained in the gas attenuation studies are included along with descriptions of apparatus for these studies and fast neutral beam studies. (J.R.D.)

12621 (USCEC-75-4) IONIZED SHOCK FRONT ANALYSIS. PART IV. PROPAGATION AND REFLECTION CHARACTERISTICS OF A UNIFORM MEDIUM WITH A NONLINEAR ELECTRICAL CONDUCTIVITY. Progress Report No. 4. Melvin Epstein (University of Southern California, Los Angeles. Engineering Center). May 31, 1961. Contract AF30(602)-2159. 26p. (RADC-TN-61-139; AD-262375)

An analysis dealing with the effect of a nonlinear electrical conductivity on the propagation of a plane electromagnetic wave through a semi-infinite uniform medium was reformulated and extended to include the effects of the nonlinear conductivity on the reflecting properties of the interface separating the plasma from free space. Attention was restricted to small degrees of the nonlinearity. The solutions of the equations indicated the following effects of a nonlinear electrical conductivity: the wave number and attenuation factor of the transmitted wave may be significantly increased; the magnitude of the transmission coefficient may be significantly reduced; and the change in phase across the interface, relative to the linear conductivity result may be either positive or negative, depending on whether the signal frequency is greater than or less than the plasma frequency. (auth)

12622 (ZPH-106(App.6)) CORRELATION FUNCTIONS IN A PLASMA. I. Oppenheim (Convair, San Diego, Calif.). June 30, 1961. Contract AF49(638)-855. 10p. (AD-261616)

The correlation function between the potential at point a and the potential at point b in a fully ionized plasma is computed. The correlation function is shown to be a long-range function of the distance between points a and b. This result has significance in the treatment of the interaction of radiation with a plasma because of its effect on transport properties in a plasma. (auth)

12623 THEORETICAL STUDIES ON CONTROLLED FUSION. M. Trocheris. Bull. inform. sci. et tech. (Paris), No. 55, 11-14(Oct. 1961). (In French)

A brief review is given of work being done at Fontenay-aux-Roses on plasma physics. The topics discussed are magnetohydrodynamic stability, models of a collisionless

plasma, statistical mechanics, and spectroscopy. Some details of the results obtained, especially on magnetohydrodynamic stability, are given. (tr-auth)

12624 EXPERIMENTAL STUDIES ON CONTROLLED FUSION. P. Hubert. Bull. inform. sci. et tech. (Paris), No. 55, 15-24(Oct. 1961). (In French)

In order to give an indication of the French research program on controlled fusion, three typical experiments are described. The direct current, magnetic mirror experiment with accelerated ion injection is under construction. Its main originality lies in the use of an annular ion source and in the system for the temporary trapping of molecular ions before dissociation. The tubular pinch experiment has shown that stable confinement of plasma can be achieved under conditions announced by theory. The electrodeless plasma gun was submitted to numerous tests revealing the great value of this device for injection into magnetic bottles. (tr-auth)

12625 CONCERNING THE STRUCTURE OF RELATIVISTIC NONLINEAR WAVES IN A PLASMA. V. N. Tsytovich (Lebedev Inst. of Physics, Moscow). Doklady Akad. Nauk S.S.S.R., 142: 63-6(Jan. 1, 1962). (In Russian)

During the traversal of a relativistic charged-particle beam through a plasma, waves are initiated which disperse with a speed close to that of light. To describe the starting system several assumptions are made. For the description of the plasma and beam, a hydrodynamical approximation, applicable for temperatures equal to zero, is used. The balancing ions are assumed to be stationary at the time of the beginning of the charge exchange between the plasma and the beam. For the description of the electron motion, the relativistic equation of gasodynamics in self-consistent fields is employed. First, some interesting properties of nonlinear relativistic waves are discussed without the presence of the beam in the plasma. Then, the example of two interpenetrating identical plasmas is used to illustrate the loss of energy of the beam in the plasma. (TTT)

12626 THE SPLITTING OF A NON-EVOLUTIONAL, MAGNETOHYDRODYNAMIC, SHOCK WAVE. V. V. Gogosov (Moscow State Univ). Doklady Akad. Nauk S.S.S.R., 142: 292-5(Jan. 11, 1962). (In Russian)

In gas dynamics it is known that the gas velocities on both side of a shock wave satisfy the relation $u_1 < c_1$ and $u_2 < c_2$, and in magnetic hydrodynamics the evolution of an explosion requires for a fast shock wave that $u_1 > c_{+2}$ and $c_{+2} > u_2 > V_2$ and for a slow shock wave that $V_1 > u_1 > c_{-1}$ and $c_{-2} > u_2$. Here u_1 and u_2 are the gas velocity components to the left and to the right of a shock wave front normal to the plane of the shock wave with coordinates related to the shock wave. The terms c_+ and c_- are the propagation velocities of the fast and slow magnetohydrodynamic waves. The term $V = H_x/\sqrt{4\pi\rho}$ is the propagation velocity of the rotary disturbance. A small perturbation of a non-evolutional disturbance, on the other hand, results in a splitting of the disturbance into a number of finite disturbances such as a shock wave, a rarefaction wave, a rotary whirl and a contact disturbance. In general, a non-evolutional shock wave should split up into six waves including one rotary disturbance and one contact disturbance. The various wave combinations that result from the splitting of a non-evolutional shock wave are analyzed as a function of the intensity of the non-evolutional shock wave. Only one rotational whorl and not two rotational whorls are produced. (TTT)

12627 DOPPLER EFFECT IN THE INVESTIGATION OF GAS DISCHARGE PLASMA. E. V. Zagoryanskaya and P. S. Kireev (Dzershinskii Moscow Inst. of Power Engineering). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 4, 163-7(1961). (In Russian)

An analysis is made of the Doppler effect on spectral line contour in a gas discharge plasma. It is shown that in addition to determining the discharge temperature, the line contour can be used for finding the ion distribution and the directions of plasma layer motion. (tr-auth)

12628 X-BAND MEASUREMENT OF SHOCK-TUBE PLASMA TEMPERATURE. S. J. Peperone (Diamond Ordnance Fuze Labs., Washington, D. C.). J. Appl. Phys., 33: 767(Feb. 1962).

Plasma radiation temperatures behind hypersonic shock waves were measured using a microwave receiver. A value of 4000°K was obtained; since no corrections were made for impedance mismatch between the source and waveguide or for finite plasma depth, the actual temperature is probably significantly higher. (L.N.N.)

12629 PLASMA TEMPERATURES AND ELECTRON DENSITIES FROM LINE BROADENING MEASUREMENTS. Natl. Bur. Standards (U. S.), Tech. News Bull., 45: 109-10 (July 1961).

A spectroscopic procedure is presented for determining electron density and temperature (if local thermodynamic equilibrium exists) of dense plasmas. Satisfactory accuracy was found. Small amounts of hydrogen were added to the gas entering the arc, and the Hβ line, broadened by the interatomic fields of electrons and ions in the plasma, was reocrded by a photoelectric spectrograph. The profile of the experimental Hβ line was then compared with theoretical curves to obtain the best fit. The theoretical curve provides the electron density from which the temperature sometimes can be calculated. (L.N.N.)

12630 INDEPENDENCE OF CONTAINMENT TIME OF A PLASMA UPON THE STRENGTH OF A MAGNETIC FIELD. Joseph Slepian. Proc. Natl. Acad. Sci. U. S., 48: 129(Feb. 1962).

In a previous paper, Proc. Natl. Acad. Sci. U. S., 47: 313(1961), the containment time of a symmetrically placed plasma with a long right cylindrical tube and subjected to a magnetic field parallel to the tube was shown to be independent of the strength of the field. The force upon the ions necessary for this is contributed by the electrons which are moving circumferentially through the same ions. A question concerning the circumferential current of positive ions was advanced, and it is shown that this current is quite negligible compared to the circumferential current of electrons, which is at least 1830 times as large. (P.C.H.)

12631 THE FORMATION AND IMPLOSION OF A CURRENT SHEET IN A GAS DISCHARGE CONTAINING REVERSED MAGNETIC FIELDS. N. J. Phillips (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 79: 171-9(Jan. 1, 1962).

A theory of the formation and implosion of a gas discharge in reversed axial magnetic fields is developed. When a discharge is formed in neutral gas containing a trapped field of opposite sense to the applied field, the formation and implosion of the discharge are influenced. A theory of the formation of a reversed field sheath in neutral gas is given, and it is shown that the sheath thickness is proportional to the plasma wavelength $(m_e c^2/4\pi n_e e^2)^{1/2}$ and weakly dependent on the ratio of scattering to ionization rates. On the basis of Buneman's theory of electrostatic instability of electron streams, it is suggested that ionization growth rates are limited by the onset of electrostatic instability when the electron temperature in the sheath exceeds a certain value (≈50 ev) determined by

the high energy behavior of the scattering and ionization rates. The implosion of the discharge can be affected by the finite resistivity of the plasma, and a simple model of the implosion of a resistive reversed field pinch is discussed. Due to field annihilation during the implosion and the effect of wall hang-up, implosions may be faster than those achieved under like field conditions. It is shown that a critical magnitude of the initial reversed field exists, above which it is amplified reversed and below which it passes through zero and is amplified with the same sense as the external field. (auth)

12632 STABILITY OF LONGITUDINAL ELECTROSTATIC OSCILLATIONS IN PLASMAS OF FINITE DIMENSIONS. E. R. Harrison (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 79: 317-25(Feb. 1, 1962).

Stability of longitudinal electrostatic oscillations in plasmas of finite dimensions is discussed. It is shown that, in general, the simple boundary conditions increase the domain of stability. Thus, a cylindrical plasma of radius a, consisting of electron and ion streams of equal temperatures and surrounded by a coaxial conducting boundary of radius b, where $b \gg a$, is stable for all stream velocities when $\lambda_D > 0.53\, a(\ln b/a)^{1/2}$, where λ_D is the Debye length. For a plane-shaped plasma of semi-width a, between parallel plane-conducting boundaries at distance b, the equivalent condition is $\lambda_D > [2(ab - a^2)]^{1/2}$. For multistream plasmas, in which the component streams have arbitrary temperatures and densities, it is possible to give a sufficient condition of stability for all stream velocities. The stability of three-stream plasmas is discussed, and it is shown that the experimental results of D. H. Looney and S. E. Brown (Phys. Rev. 93: 965(1954)) are in accord with the stability criteria for plasmas of finite dimensions. Attention is drawn to the similarity between plane shaped plasmas and auroral arcs, and the similarity between cylindrical shaped plasmas and auroral rays. It is suggested that the difference of the stability conditions for plane and cylindrical shaped plasmas may account for the tendency of auroral arcs to disrupt into rayed structures. (auth)

12633 ENERGY LOSS PROCESSES IN ZETA. A. Gibson and D. W. Mason (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 79: 326-50(Feb. 1, 1962).

The energy lost from ZETA discharges in deuterium and argon by radiation, plasma particles, and non-thermal electrons was investigated experimentally. Two definite regimes of energy loss were established. These are determined principally by the pressure at which the machine is operated. At high pressures (5 μ) line radiation from impurities is the dominant loss process and, under certain discharge conditions, accounts for all the energy fed into the discharge. Theoretical considerations are presented to show that the observed impurity content of 10^{11} atoms per cm^3 can account for the radiation loss. At lower pressures (0.5 μ) the energy is lost by particles, by plasma not efficiently confined, and by fast electrons accelerated at the termination of the current pulse and striking the tube walls at about 8 kev. Results are related to energy loss observations using other stabilized pinch devices. (auth)

12634 THE EFFECT OF POSITIVE IONS ON THE PROPAGATION OF ELECTROMAGNETIC WAVES IN MAGNETIC PLASMAS. Gerhard Seeger (Technische Hochschule, Munich). Z. angew. Phys., 13: 551-60(Dec. 1961). (In German)

The propagation of electromagnetic waves in a neutral streaming plasma with a constant imposed magnetic field, in which the charge carriers consist of both electrons and positive ions, was investigated. It was shown that at very low frequencies and collision numbers, field decoupling occurs as a result of a compensation between electrons and positive ions. One wave type is propagated independently of the angle between the wave normal and the magnetic field and the other is angle dependent. At higher frequencies, no decoupling in the unlimited plasma may be assumed, although the positive ions are essentially decisive for the propagation ratios so long as the electron collision number is small with respect to the electron gyrofrequency. Approximations for the dielectric constants and refractive indices in the pertinent frequency ranges are discussed, in which the effect of the losses, especially in the vicinity of the "resonance sites", is introduced. For metallic limited plasma, it was shown that field decoupling can be assumed at very high frequencies so long as the total frequency of the apparatus is high enough above the plasma eigenfrequency. The propagation constant was derived for this case. It was shown that in addition to the damping caused by ion collision, a strong effect of the electron collision number occurs as a result of the longitudinal field components. (tr-auth)

12635 IONIZATION AND STATE EQUATION OF A PLASMA UNDER HIGH PRESSURES AND TEMPERATURES. K. H. Schramm (Battelle-Institut e. V., Frankfurt am Main). Z. Physik, 165: 336-55(1961). (In German)

The state of a thermal plasma in the range of states from 10^{4}°K < T < 10^{6}°K and $p \leq 10^{3}$ atm is discussed. In this region, the degree of ionization explicitly depends not only on the temperature, but also on the pressure. This pressure ionization and its consequences in connection with the thermal ionization on the state of the plasma were investigated for a simplified model of a hydrogen plasma. The cases of non-degenerate and of highly degenerate electrons are discussed. (tr-auth)

12636 DETERMINATION OF THE VISCOSITY OF A CARBON ARC PLASMA IN THE TEMPERATURE RANGE BETWEEN 5000 AND 10,000°K. B. Ahlborn and R. Wienecke (Universität, Kiel). Z. Physik, 165: 491-501(1961). (In German)

The viscosity of the plasma of high-current carbon arcs was determined as a function of the temperature from measurements of the velocity field. The comparison with a gas kinetic calculation yields a satisfactory agreement with the measured viscosity pattern. (tr-auth)

12637 HYDRODYNAMICS OF A NONISOTHERMAL PLASMA. E. E. Lovetskii and A. A. Rukhadze (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 1845-9(Dec. 1961). (In Russian)

Single-fluid magnetic hydrodynamical equations for a nonisothermal plasma are deduced by taking into account particle collisions. The effect of particle collisions on the spectrum of the hydrodynamic and magnetoacoustic waves in the plasma is investigated. (auth)

12638 CONTRIBUTION TO THE THEORY OF ELECTROMAGNETIC FLUCTUATIONS IN A NON-STEADY STATE PLASMA. F. V. Bunkin (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 1859-67(Dec. 1961). (In Russian)

Components of the tensor for the spectral intensity of the fluctuations of an electric current, in a nonrelativistic magneto-active plasma located in strong varying electric and magnetic fields, are calculated. From the electrodynamical viewpoint such a plasma can be regarded as a

medium with time-variable parameters. Some general properties of such a medium are considered. (auth)

12639 RADIATION OF A PLASMA WAVE BY A CHARGE MOVING IN A MAGNETOACTIVE PLASMA. V. Ya. Eidman (Gorkii State Univ., USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1971-7(Dec. 1961). (In Russian)

The spectral and angular distribution of the energy of a plasma wave radiated by a charge moving in a magnetoactive plasma is determined, with space dispersion taken into account. (auth)

12640 STRUCTURE OF SHOCK WAVES IN A HIGH TEMPERATURE DENSE PLASMA. V. S. Imshennik. Zhur. Eksptl'. i Teoret. Fiz., 42: 236-46(Jan. 1962). (In Russian)

The structure of a shock wave of arbitrary strength in a plasma is investigated in the two-temperature hydrodynamic approximation. Electron thermal conductivity and energy exchange between the ions and electrons are taken into account. The role of radiation is also taken into account. Two types of solutions are found, a continuous one and a discontinuous one with an isoelectron-thermal discontinuity. They depend on the wave strength and the fraction of radiation pressure in the initial state of the plasma before the front. The conditions of appearance of a discontinuity also depend on the plasma parameters (ion charge Z, adiabatic exponent γ) and have a simple physical meaning. (auth)

12641 THEORY OF FLUCTUATIONS OF PARTICLE DISTRIBUTION IN A PLASMA. Yu. L. Klimontovich and V. P. Silin. Zhur. Eksptl'. i Teoret. Fiz., 42: 286-98 (Jan. 1962). (In Russian)

Phase density correlations at various phase space points and at various moments of time are derived for a nonequilibrium plasma. General formulas are used for obtaining expressions for field correlations, charge density and particle distribution and charge density correlations. The case of a plasma in a constant homogeneous magnetic field is considered. (auth)

12642 INSTABILITY OF POSITIVE PLASMA IN SHORT DISCHARGE TUBES IN LONGITUDINAL MAGNETIC FIELD. A. V. Timofeev. Zhur. Tekh. Fiz., 31: 1420-5(Dec. 1961). (In Russian)

The instability of a positive column in a short gas discharge tube was analyzed, and it was found that in a sufficiently short tube the first harmonics (along the azimuth) are not excited. With further shortening of the tube, the column becomes stable in relation to all harmonics. (tr-auth)

12643 EXCITATION OF MAGNETOHYDRODYNAMIC WAVES IN ANISOTROPIC PLASMA. A. D. Pataraya and D. G. Lominadze (Inst. of Physics, Academy of Sciences, Georgian SSR). Zhur. Tekh. Fiz., 32: 44-7(Jan. 1962). (In Russian)

The excitation of magnetohydrodynamic and magnetoacoustic waves in anisotropic plasma is analyzed by means of alternating currents. The emission intensity was evaluated. (tr-auth)

12644 EXPERIMENTAL STUDIES OF PLASMA DIFFUSION BREAK UP IN MAGNETIC FIELD. [PART] II. V. E. Golant and A. P. Zhilinskii (Leningrad Polyetechnic Inst.). Zhur. Tekh. Fiz., 32: 127-9(Jan. 1962). (In Russian)

The diffusion break-up of plasma in helium was studied at 0.02 to 0.8 mm pressure and up to 2400 gauss magnetic fields. (R.V.J.)

Shielding

12645 (DC-60-4-172) A COMPARISON OF CALCULATED AND MEASURED CREW SHIELD CAPTURE GAMMA RAYS (MILESTONE 2, TASK 431321, JOB 51293). L. S. Burns, Jr. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 27, 1960. Contract AT(11-1)-171. 23p.

A method of calculating crew-shield capture gamma rays is presented. Comparison of results of the calculations by this method and measurements shows that the method is a satisfactory temporary approach until more accurate methods are completed. Experimental data are shown to demonstrate the importance of the dose rate from the capture gamma rays. (auth)

Theoretical Physics

12646 THE THEORY OF NUCLEAR ROTATIONS. Lothar Meichsner. Z. Naturforsch., 16a: 1119-24(Nov. 1961). (In German)

Calculations of the moments of inertia of heavy nuclei without taking into account nucleonic interactions yielded values about twice the experimental ones. Such calculations were done at the Max-Planck-Institut für Physik for some rare-earth nuclei. A paper (Nuclear Phys., 8: 493 (1958)) written by the author at the same institution offers a better agreement if the nucleonic interactions again are neglected. It considers the fact that the nucleons do not move independently of one another in the rotating system of coordinates since introduction of Eulerian angles necessarily imposes secondary conditions on the relative coordinates of the nucleons. In consequence of this, an additional energy term, called "Zwangsenergie," occurs. After presenting the main results of the mentioned paper it is shown that this additional term alters energy differences entering the effective reciprocal moments of inertia in the sense of enlarging these moments, i.e., diminishing the effective moments of inertia, and that this contribution is not negligible. The theory presented differs from that of Inglis by treating the rotations of the axially deformed potential quantum-mechanically instead by the help of a classical angular velocity. (auth)

12647 ON THE THEORY OF QUANTIZATION OF SPACE-TIME. V. G. Kadyshevskii (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1885-94(Dec. 1961). (In Russian)

It is proposed that the geometric structure of x-space in small scale and correspondingly of ρ-space (momentum space) in large scale is closely connected with weak interactions of elementary particles. Furthermore, a scheme is investigated in which momentum space is one of constant curvature and x-space is quantized. It is demonstrated that in this new geometry there are reasons for rejecting the requirement of invariance under space inversion and strong time inversion, providing the CPT theorem is correct. (auth)

12648 ON THE INTERACTION HAMILTONIAN IN QUANTUM FIELD THEORY. A. D. Sukhanov (Inst. of Mathematics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1915-28(Dec. 1961). (In Russian)

The problem of obtaining the interaction Hamiltonian in quantum field theory is considered. The expression for the Hamiltonian found by the Bogolyubov method is analyzed, particularly for theories with derivative coupling. It is

shown that this expression satisfies the integrability condition for the Tomonaga-Schwinger equation for any renormalized theory. It is also established how the nonphysical dependence on the shape of the intermediate surfaces can be removed from the S-matrix in this method, and also how gauge invariance of the S-matrix can be attained for scalar electrodynamics in the Klein–Gordon formalism. All the results are derived without taking into account "surface divergences," a problem that remains open. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstract 11863

12649 (ANL-6485) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, DECEMBER 1961. (Argonne National Lab., Ill.). Jan. 15, 1962. Contract W-31-109-Eng-38. 63p.

Reactor and general engineering research progress is summarized for EBWR, BORAX-V, ZPR-III, ZPR-VI, ZPR-IX, EBR-I, and EBR-II. Fast and thermal reactor safety studies are described. Nuclear technology investigations are discussed for applied nuclear physics, reactor fuels and materials development, heat engineering and fluid flow, separations processes, and advanced reactor concepts. (B.O.G.)

12650 (BMI-1561(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING DECEMBER 1961. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Jan. 1, 1962. Contract W-7405-Eng-92. 73p.

Progress is reported on development of reactor materials and components. Studies were made of fuels, general fuel-element development, growth of UO_2 single crystals, radioisotope and radiation applications, materials development and evaluation, development of coated-particle fuel materials, corrosion studies of the Fluoride Volatility Process, USAEC/AECL cooperative program, radiation-effects study of candidate fuel materials for the MGCR, materials development studies for SM reactors, the gas-cooled reactor program, and gas-pressure bonding of beryllium-clad elements. (M.C.G.)

12651 (BMI-1568) EVALUATION OF THORIUM AND THORIUM-URANIUM COMPOUNDS AS THERMAL BREEDER FUELS. Martin S. Farkas, Arthur A. Bauer, and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Feb. 15, 1962. Contract W-7405-eng-92. 20p.

Cylindrical arc castings of near theoretical density of Th_2Al, ThB_4, $ThBe_{13}$, ThC, ThC_2, Th_3Si_2, and ThSi, without and with the substitution of 10 at.% uranium for part of the thorium, were prepared. Microstructural studies showed that, with the exception of the aluminide, the uranium replaced the thorium in solid solution in the compounds. Hardness measurements of all compounds indicated considerable strength, especially for the borides and beryllides. Oxidation tests in dry air and CO_2 at 1100°F indicated greatest oxidation resistance for the borides and beryllides while the aluminides and silicides reacted extremely rapidly; the carbides exhibited intermediate resistance. All of the compounds showed negligible attack by NaK at 1200°F and, except for the silicides, which exhibited measurable corrosion rates, the behavior of the compounds was roughly comparable in Santowax R at 660°F. In water at 195°F the carbides disintegrated rapidly while the borides and beryllides showed no evidence of corrosion; the aluminides and silicides corroded slowly under the same conditions. (auth)

12652 (DPST-62-162) MINUTES OF FOURTH MEETING OF REACTOR DECONTAMINATION INFORMATION EXCHANGE GROUP AT SRP, NOVEMBER 30–DECEMBER 1, 1961. (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Contract AT(07-2)-1. 33p.

Items associated with decontamination such as disposal of spent decontaminants, costs, crud transport, and redeposition are discussed. Summaries prepared by representatives of AECL, Alco Products, ANL, General Atomics, HAPO, VAL, ORNL, WAPD, and SRL are included. (J.R.D.)

12653 (EURAEC-130) USE OF PLUTONIUM AS FUEL IN NUCLEAR REACTORS. Quarterly Report No. 4, April–June 1961. (Société Belge pour l'Industrie Nucléaire, Brussels). July 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract [027-60-7RDB]. 63p.

First results on Pu oxalate solubility show a minimum value of 21.9 mg Pu/l. Continued work on research to establish the various factors affecting PuO_2 dissolution and purification of Pu salts by ion exchangers is reported. In other work, it was found that Pu concentrations up to 10^{-5} g do not impede the fluorimetric determination of U. Fabrication of ceramic fuels such as plutonium carbide, UO_2–C mixtures and UO_2 is discussed along with dilatometric results on PuO_2 and PuO_2–UO_2 shapes. Investigations of dispersed fuel properties are also reported. (J.R.D.)

12654 (GEMP-106C) HIGH-TEMPERATURE MATERIALS AND REACTOR COMPONENT DEVELOPMENT PROGRAMS. VOLUME III. REACTOR COMPONENT DEVELOPMENT. First Annual Report. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Feb. 28, 1962. Contract AT(40-1)-2847. 38p.

Work in process on reactor component development during calendar year 1961 is reported. Eight specific development programs are reported including those on circulating ball reactivity control with capability of operating around sharp bends, static switching utilizing solid-state devices, capacitance temperature sensors based on the change in dielectric constant of alumina or beryllia vs. temperature change, high-temperature extension of conventional nuclear sensors (fission counters and d-c ionization chambers), nuclear sensors for monitoring and controlling high-temperature, high-performance reactors, high-temperature fasteners involving stress relaxation of Inconel bolts and nuts up to 600°C, fasteners for remote maintenance, and Monte Carlo program for nuclear analysis of complex reactor and shield systems. Results indicate the positive feasibility of moving small magnetic rods with a length-to-diameter ratio of approximately two, by means of a linear electrical induction-type drive; moving balls of magnetic material does not appear feasible. In other work, a temperature sensor, basing its sensing ability on the change in dielectric of alumina with temperature, was successfully operated up to 1000°F, and two fission counters demonstrated satisfactory operation to 1500°F for times in excess of 150 hours each. Program packages for the present version of the three major Monte Carlo digital computer programs and necessary auxiliary programs were compiled and delivered to the twelve requesting installations. (auth)

12655 (MND-M-1859) REACTOR FLOW STUDIES; FULL SCALE MODEL FLOW TESTS. W. J. Taylor, I. Starr, and R. L. Baer (Martin Co. Nuclear Div., Baltimore). June 1961. Contract [AT(30-1)-2345]. 122p.

A test program to verify the hydraulic design of the PM-1 reactor vessel and core is described. A full-scale model installed in a low-pressure, low-temperature, water-flow loop was used. It was found that flow distribu-

tions in the core, the water-box orifice plate, and through the thermal shield annuli were uniform. (J.R.D.)

12656 (NUMEC-P-90) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Progress Report, October 1–December 31, 1961. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT(30-1)-2389. 80p.

Continued effort is reported on preparation and characterization of PuO_2 and UO_2–PuO_2 mixtures. Sintering and characterization of pellets for irradiation tests was emphasized, and efforts were also devoted to plasma torch production of spherical PuO_2 and coating of oxide materials. PuO_2 produced by the oxalate process from low concentration feed contains agglomerates which are not readily broken down, while that produced from normal feed contains larger agglomerates which are easily dispersed ultrasonically, and are more easily calcined. The water filtration method for determining total porosity of powders was adapted for use with PuO_2. Moisture pickup studies show that the problems encountered with PuO_2 are similar to those found in handling ceramic-grade UO_2. Reproducibility tests carried out on UO_2–PuO_2 mixtures indicate that production methods are satisfactory. Lab-scale experiments on production of PuO_2–UO_2 feed for the plasma torch indicate that further work is worthwhile. Adaptation of a potentiometric filtration for Pu is reported. A two-phase microstructure found in PuO_2 after sintering in N-6% H atmosphere was identified as PuO_2 and cubic Pu_2O_3. Spherical particles were produced in the plasma torch using crushed or preformed high-fired particles. Spherical particles of PuO_2 were also produced by a multi-step process of drying, pressing, granulation, sizing, shaping, and sintering. Reactor physics studies were continued to determine the effect of cross section assumptions on the calculated behavior of Pu-fueled near-thermal reactor systems. It was concluded that relatively long core life (reactivity limiting) is attainable with these systems. (J.R.D.)

12657 (RAE-TM-MET-PHYS-215) PROGRESS REPORT ON URANIUM–THORIUM–CARBON FUELS. R. L. Bickerdike, G. Hughes, and H. Ranson (Gt. Brit. Royal Aircraft Establishment, Farnborough, Hants, England). Oct. 1960. 23p.

Fission product emission from cellulose carbon fibers containing UO_2 was investigated. The use of cellulose to form fuel inserts is complicated by the large carbonizing shrinkage, but methods of forming uranium and thorium carbide-containing shapes were partially developed. Cotton fiber retained a satisfactory quantity of uranium from a dyeing process. Two forming methods were used for making discs and rings, both employing a phenol-formaldehyde resin as a bond. The discs and loose fiber were heated in argon to a sufficiently high temperature to convert the uranium and thorium to the dicarbides. Then the carbides were coated with carbon. The structure of the material after carbon deposition was investigated. Results of tests suggested that in the deposited state the material has a low thermal conductivity. (M.C.G.)

12658 (RISÖ-33) SOME NUMERICAL DETERMINATIONS OF THE EFFECTIVE NEUTRON TEMPERATURE OF A GIVEN THERMAL-NEUTRON SPECTRUM. P. Villemoes and B. Fastrup (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Jan. 1962. 30p.

The thermal neutron spectrum of a reactor may be approximated by a Maxwellian distribution with an effective neutron temperature T_n. Experimental methods for the determination of T_n are investigated, and their temperature criteria are shown to be different. A numerical investigation of these criteria is carried out. In a given theoretical neutron spectrum the results of experiments like transmission through a 1/v absorber, reaction-rate determination in a non-1/v absorber, and a least squares fit to a Maxwellian spectrum are compared. (auth)

12659 (TDV-3) CANDU DUMP PORT HEAD LOSS COEFFICIENTS. R. Isles (Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto). Sept. 1961. 21p. (AECL-1394)

The effects on the head loss coefficient of changes in throat dimensions, bulb diameters, and flow vanes are investigated for CANDU. Head loss coefficients are presented for 16 modifications of the dump ports. (auth)

12660 (TID-14979) GLASS FABRIC SWATCH TESTS ON SODIUM AND NaK FUMES FOR ATOMICS INTERNATIONAL. John D. Harms (American Air Filter Co., Inc., Louisville, Ky.). June 9, 1961. Contract [AT(11-1)-Gen-8]. 11p.

Tests were made on the feasibility of using a glass bag cloth collector for removing Na and Na–K fumes. Results of studies on uncoated fabric indicated that Medardi 600 glass fabric is superior to 501/54 fabric. Studies of precoated Menardi 600 fabric showed that efficiencies >90% on Na or Na–K fumes can be obtained with precoat loadings of asbestos as low as 5 g/ft^2. (D.L.C.)

12661 (UNC-3001) NUCLEAR FUEL RESEARCH FUEL CYCLE DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT, OCTOBER 1–DECEMBER 31, 1961. (United Nuclear Corp. Fuels Div., New Haven). Feb. 1, 1962. Contract AT(30-1)-2374. 34p.

The irradiation testing program involving enriched UO_2 capsules fabricated by low-temperature sintering was continued. Flux monitor data indicate an average burnup level in the capsule of 5800 Mwd/t compared with 9100 Mwd/t calculated. Preparation of 5 different high-purity UC irradiation test specimens of 12% enrichment is reported. Descriptions of UC preparation procedures by the propane reaction and by skull melting are included. (J.R.D.)

12662 (WAPD-BT-24) BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Dec. 1961. Contract AT(11-1)-Gen-14 and appropriate NObs-Contracts. 104p.

Seven papers are included for six of which separate abstracts were prepared. One paper, on comparison of measured and calculated thermal neutron distributions in high-temperature water shielding, was previously abstracted in NSA. (J.R.D.)

12663 (WAPD-BT-24(p.1-17)) FISSION PRODUCT DECAY ENERGY. K. Shure (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Knowledge of the energy released from fission products in the form of beta and gamma radiation is necessary in such aspects of reactor design as the calculation of heat generation and refueling shielding requirements. Experimental data was accumulated which is applicable over various ranges of times after fission, and additional studies based on these data were made. The information currently available is reviewed, and what is considered to be most reliable is presented in a manner suited for calculation. (auth)

12664 (WAPD-BT-24(p.27-42)) SOME ADDITIONAL STUDIES ON THE HYDROGEN PICKUP BY ZIRCALOYS-2 AND -4 DURING CORROSION IN HIGH-TEMPERATURE WATER AND STEAM. S. Kass and W. W. Kirk (Westing-

house Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Experimental work performed to develop additional information on the corrosion behavior of Zircaloy-2, Ni-free Zircaloy-2, and Zircaloy-4 is described. Information is included from investigations of corrosion and H pickup properties of Ni-free Zircaloy-2, high-temperature steam corrosion of Zircaloy-2 and Zircaloy-4, and H pickup of the Zircaloy-2 alloys during corrosion by hydrogenated water. (auth)

12665 (WAPD-BT-24(p.43-63)) EXPERIMENTAL PRESSURE-DEFLECTION AND FATIGUE PROPERTIES OF ZIRCALOY DIAPHRAGMS. E. F. Losco, R. Leggett, R. Lacerte, F. O. Bingman, and C. R. Woods (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Plate-type fuel elements containing compartmented and unbonded ceramic fuel are of considerable interest because of their high thermal performance and long-life capabilities. The unbonded Zircaloy cladding elements over individual fuel compartments in these plates are essentially thin diaphragms, fixed at the edges and subject to deformation under the action of hydrostatic pressure. The pressure-deflection and fatigue characteristics of such diaphragms under a variety of out-of-pile temperature and pressure conditions were determined experimentally. (auth)

12666 (WAPD-BT-24(p.65-84)) IRRADIATION BEHAVIOR OF BORON-10 IRON-BASE ALLOYS. W. Yeniscavich, R. G. Gray, and H. B. Meieran (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Alloys of iron, ferritic stainless steel, and austenitic stainless steel, each containing a 2 wt % boron (enriched to 92% B^{10} in total B), were neutron-irradiated to depletions as high as 95% of the B^{10} atoms. The irradiation behavior, post-irradiation corrosion testing, and post-irradiation annealing of these alloys indicated a submicrocrack mechanism of irradiation damage. The formation of submicrocracks and their growth into observable microcracks are discussed, along with reactor limitations imposed on these alloys by this mode of irradiation damage. (auth)

12667 (WAPD-BT-24(p.85-8)) Co^{58} ANALYSIS BY GAMMA-GAMMA COINCIDENCE COUNTING. L. D. McIsaac and R. S. Ulrich (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

The coincidence counting device described was developed to provide a means of rapidly determining the Co^{58} activity in samples having Co^{60} as the dominant activity. Using this device, Co^{58} activity upon deposition specimens was determined in situ, even though Co^{58} is but a small fraction of the deposited Co^{60} activity. (auth)

12668 (WAPD-BT-24(p.89-98)) THE DETERMINATION OF SUBMICROGRAM AMOUNTS OF COBALT AND MANGANESE IN SAMPLES OF RADIOACTIVE STAINLESS STEEL OXIDES. G. C. Owens (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

A neutron activation analysis of Co and Mn in an oxalic acid solution of stainless steel oxides obtained by ultrasonic descaling of reactor components is described. Samples are irradiated for five minutes, and duplicate gamma spectra are taken for each solution, using first a thin, then a thick, crystal for counting. The samples are counted without purification. For the analyses required to study and control Co and Mn in reactor cooling water, a 0.95 confidence range of ±10% is satisfactory. The method meets this criterion for both Co and Mn. (auth)

12669 (WCAP-1933) OPERATING EXPERIENCE AND ACTIVITIES FOR THE CRX FACILITY. Annual Report, 1961. D. F. Hanlen and W. J. Eich (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Jan. 29, 1962. 43p.

The physical plant of the Critical Reactor Experiment facility is described. Critical-experiment type research on multiregion reactor cores, consisting of cylindrical or slab loadings of slightly enriched UO_2, is reviewed. The effects on the power distribution and core reactivity of the use of thimble control elements are reported. Critical experiments performed in order to evaluate techniques and methods used in the analysis of long-lived multiregion cores using low-enrichment UO_2 fuel and water moderators are outlined. Hazards analyses performed for each core configuration used are discussed. (T.F.H.)

12670 (AERE-Trans-879) SYNTHESIS OF REACTOR CONTROL SYSTEMS, INCLUDING THE CONSIDERATION OF RADIAL SPATIAL BEHAVIOUR. T. Kagayama. Translated by S. G. Brickley (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Nippon Genshiryoku Gakkaishi, 2: 78-88(1960). 38p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 13452.

12671 MULTIZONE REACTOR CALCULATIONS. Krystyna Kowalska (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 6: 157-68 (1961). (In English)

Critical size and neutron density distributions of the zero power assembly and second Polish experimental reactor were calculated for 20 and 90% fuel enrichment. Calculations of the neutron trap in a water reactor and an enriched uranium-water moderated-natural uranium-graphite moderated core are illustrated. Calculations were carried out on the Polish digital computer, XYZ, by a known difference method. (auth)

12672 REACTOR KINETICS WITH SURFACE PERTURBATION. Ryokichi Tanaka (Atomic Power Lab., Technical Research Lab., Kawasaki Dock-yard Co., Ltd., Japan). J. At. Energy Soc. Japan, 4: 45-51(Jan. 1962). (In Japanese)

Reactor kinetics with the surface deformation of an outer reflector was solved by a perturbation method. A diffusion equation was transformed into an integral equation to obtain the time components of the neutron flux corresponding to surface deformations. As compared with the ordinary perturbation such as the insertion of a poison, in which the outer boundary of the reactor is fixed, treatment is given to extra terms besides the main source term of a surface integral. As examples, five cases of surface deformations were treated and the corresponding neutron flux responses were derived for the one-dimensional slab reactor. The method studied is applicable directly to a multigroup diffusion model. (auth)

12673 PRESENT STATUS OF REACTOR THEORY FROM VIEWPOINT OF REACTOR DESIGN. Yuzo Fukai (Nippon Atomic Industry Group Co., Japan). J. At. Energy Soc. Japan, 4: 52-64(Jan. 1962). (In Japanese)

The present status of reactor theory is considered from viewpoints of reactor design. Discussion is given on calculation cost; fundamental problems such as evaluation of cross section value, solutions of Boltzmann transport equation, neutron slowing down, and criticality problems; methods for criticality calculations; and recent problems on neutron resonance, thermalization, and breeding. A brief discussion is also given on time dependent problems. (auth)

12674 CHEMO-NUCLEAR REACTIONS AS LARGE RADIATION SOURCES. H. Krauch, W. Baur, K. Jecht, and W. Kunz (Studiengruppe für Angewandte Radio- und Strahlenchemie, Heidelberg). Kerntechnik, 3: 522-6(Dec. 1961). (In German)

Chemo-nuclear reactions are reactions in which the radiation released by nuclear fission is applied directly to the induction of chemical reactions. Prototypes of chemo-nuclear reactors have been designed. However, a separation of core and process steam would, in contrast to these designs, allow the production of high quality steam and would be much more feasible economically. Two designs for such "blanket chemo-nuclear reactors" are described. The ionization of the process steam is induced by pile irradiation or by fission fragment bombardment, produced by subcritical fission of U^{235} in the blanket. The use of neutron transformers is evaluated as a primary step in the construction of such reactors. (tr-auth)

12675 FAST REACTORS. T. Auerbach (ETH, Würenlingen, Switzerland), K. Boub, Th. Schaub, and P. Schmid. Neue Tech., 3: 612-26(Oct. 1961). (In German)

The future prospects of fast breeder reactors for the utilization of nuclear energy are investigated in the light of the latest literature. Besides the reactor physics and the thermal aspects of the general layout, the technology of the fuel elements, the major components, and the fuel cycle are discussed. It turns out that fast breeders, compared to more conventional reactor types, allow a fifty times more efficient utilization of natural nuclear energy resources. In order to reach this goal under economically favorable conditions, however, further research and development efforts are indispensable. Switzerland might well contribute to the development of the fast breeder technology in the framework of common projects. (auth)

12676 LIQUID FUEL REACTORS. J. L. Meylan (EPF, Würenlingen, Switzerland), J. M. Pictet, and H. R. von Gunten. Neue Tech., 3: 656-79(Oct. 1961). (In French)

The three fluid-fuel reactor groups (aqueous homogeneous reactor, molten-salt reactor, and liquid metal fuel reactor) are reviewed. Each concept is separately evaluated and the most promising types are briefly described. After comparison, it is concluded that the molten-salt reactor offers the most advantages. (auth)

12677 AN EXPERIMENTAL EQUIPMENT FOR THE RAPID RECOGNITION OF EXCURSIONS IN REACTORS AT LOW FLUX LEVELS. C. H. Vincent and R. J. Lamden (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 14: 143-59(Dec. 1961). (In English)

Excursion detection equipment is subjected to extensive experimental tests. These tests confirm that the equipment can give warning of the commencement of an excursion in a time little greater than the theoretically predicted absolute minimum time, over a wide range of conditions. The response of the equipment can be limited so that it does not respond to longer periods, such as would be used to effect controlled increases in power level, at the expense of some loss of performance for periods just below the limit. The performance for very short periods remains unimpaired. (auth)

12678 DETERMINATION OF REACTOR TRANSFER FUNCTIONS BY STATISTICAL CORRELATION METHODS. V. Rajagopal (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 12: 218-24(Feb. 1962). (BNL-5456)

An experimental investigation was made of the self-fluctuations in neutron density in a reactor, and the response in neutron density for random reactivity inputs, using analog correlation techniques. The analysis of self-fluctuations was based on ion chamber measurements of the fluctuations of neutron intensity at various points. Autocorrelation analysis was then used to find the power spectrum of the fluctuations, which has the shape of square modulus of transfer function. A random reactivity input was realized by using an electromechanical system to convert the white noise of a radioactive source into linear motion of a small neutron absorber. Analysis of the response was made by autocorrelating the reactivity input and cross-correlating the reactivity input and the response in neutron density, and determining their spectra. The amplitude and phase of the reactor transfer function were determined from these spectra. Results are presented on some measurements made on a small reactor at Brookhaven National Laboratory. The measured transfer function agrees with the calculated transfer function. (auth)

12679 EFFECTIVENESS OF LINING MATERIALS IN INCREASING THE BLAST RESISTANCE OF A SIMULATED OUTER CONTAINMENT VESSEL FOR A NUCLEAR REACTOR. J. W. Hanna and W. O. Ewing, Jr. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Nuclear Sci. and Eng., 12: 234-7(Feb. 1962).

A five-foot-diameter, spherical, thin-walled, steel shell, simulating a reactor outer containment vessel, was lined with three different shock-absorbing materials and subjected to internal blast loading from Pentolite explosive charges. Strain-time histories of shell response were measured with strain gages on the outer surface of the shell. Peak strains generated in the lined shells were approximately one-half those recorded with the same shell when unlined. The results suggest the feasibility of increasing the blast resistance of outer containment vessels through the use of a suitable lining material. (auth)

12680 MEASUREMENT OF THE DANCOFF CORRECTION. J. Hardy, Jr., G. G. Smith, J. A. Mitchell, and D. Klein (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 12: 301-8(Feb. 1962). (WAPD-T-1255(Rev.))

The Dancoff correction factor $(1 - C)$ for U^{238} resonance neutron capture was measured for cylindrical, 0.98 cm diameter fuel rods at lattice pitches of 1.81 and 1.44 cm. The rods were 1.3% U^{235}, arranged in a hexagonal, H_2O-moderated lattice. Measurements were done for three fuel materials: uranium metal, UO_2 (density 10.5 gm/cm^3), and UO_2 (density 7.5 gm/cm^3) according to the following method. The ratio of U^{238} epicadmium neutron capture per atom at rod surface to that at rod center, S/V, was measured at both lattice pitches and in an isolated rod (i.e., no Dancoff interaction). The quantity $R = [(S - V)/V]_{lattice} / [(S - V)/V]_{isolated\ rod}$ was, within experimental error, the same for all three fuel materials at each lattice pitch. Furthermore, R was found to be equal to $(1 - C)$, calculated at each lattice pitch from Dancoff's expression. This agreement was expected from an analysis of the experiment in terms of a current model of resonance capture which indicated that R equals $(1 - C)$ multiplied by two factors: one accounting for lattice mutual shielding of capture at rod center, the other accounting for the effect on S/V of the resonance flux lethargy tilt (due to loss of neutrons by resonance capture). Approximate calculations of these two effects showed that each perturbs R by about 10% in the worst case. The effects oppose each other so that very closely $R = 1 - C$. (auth)

12681 THERMAL FLUX DISADVANTAGE FACTORS FOR SLAB GEOMETRY. Chander P. Bhalla (Westinghouse

Atomic Power Dept., Forest Hills, Penna.). Nuclear Sci. and Eng., 12: 311-13(Feb. 1962).

A simple method based partly on blackness theory and Theys' method (based on the Integral Transport Theory) is described for calculating thermal flux disadvantage factors for fuel slabs. The calculations are compared with those performed with Theys' method and the DSN (S-8) method. The results show that the method is in better agreement with the S-8 calculations than Theys' method. (N.W.R.)

12682 BORON TRIFLUORIDE AS A SOLUBLE POISON IN MOLTEN SALT REACTOR FUELS. J. H. Shaffer, W. R. Grimes, and G. M. Watson (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 12: 337-40(Mar. 1962).

Control of a molten salt reactor by adjustment of the concentration of a nuclear poison that can be readily added to and removed from the circulating fuel is studied. This chemical control can be used, if necessary, in addition to the negative temperature coefficient of reactivity that plays a major role in the control of liquid fueled reactors. Gaseous boron trifluoride (enriched in B^{10} if desired) may serve as a nuclear poison soluble in the fuel mixture of a molten salt reactor. The concentration of boron trifluoride in the liquid is proportional to and can be controlled by its partial pressure over a free surface in the circulating system. The solubility behavior of BF_3 as a function of pressure and temperature defines the capacity of the fuel for BF_3 and establishes the limits of possible usefulness of this compound as a removable reactor poison for reactor control. Experimental measurements of the solubility of BF_3 in a molten fluoride mixture suitable for Molten Salt Reactor Experiment (MSRE) applications are determined. The MSRE is a 10 Mw(th) circulating fuel reactor moderated with unclad graphite in contact with a mixture of molten fluoride salts containing uranium tetrafluoride. Values of Henry's law constants are obtained (in moles of BF_3 per liter of solution per atmosphere) of 0.265, 0.145, 0.0846, and 0.0351 at 500, 550, 600, and 700°C, respectively. These high solubilities indicate that BF_3 should be suitable for control purposes of a molten salt reactor even at very moderate partial pressures. At reactor temperatures, and with a BF_3 partial pressure of one atmosphere, an average atomic ratio of boron to U^{235} of 0.4 in the liquid is estimated. Simplified calculations of the distribution of boron between the fuel and the graphite moderator are made. Indications are obtained, neglecting adsorption effects, that 85% of the boron remains in the liquid even assuming complete equilibrium intrusion of the graphite pores by gaseous BF_3. (auth)

12683 EXPERIMENTAL BUCKLINGS OF HEAVY WATER MODERATED LATTICES OF NATURAL URANIUM METAL ROD CLUSTERS. T. J. Hurley, Jr., H. R. Fike, and G. F. O'Neill (E. I. du Pont de Nemours & Co., Aiken, S. C.). Nuclear Sci. and Eng., 12: 341-7(Mar. 1962).

Studies performed in the Process Development Pile of the Savannah River Laboratory provide precise measurements of the material bucklings of a number of D_2O-moderated lattices of natural uranium metal rods over an extended range of fuel assembly sizes and lattice pitches. The 1-in. uranium rods are clad with 0.032 in. of aluminum. Fuel assembly sizes vary from single rods to clusters of 3, 7, and 19 rods (0.09 to 1.81 kg U/cm) and lattice spacings from 7.00 to 21.00 in., covering a range of moderator-to-fuel volume ratios from 10.23 to 161.53. A few lattices are studied at different D_2O purities, in loadings of different sizes, and in reflected loadings. (auth)

12684 EXPONENTIAL MEASUREMENTS OF NATURAL URANIUM RODS IN HEAVY WATER AND COMPARISONS WITH CRITICAL EXPERIMENTS. E. C. Wingfield and E. J. Hennelly (E. I. du Pont de Nemours & Co., Aiken, S. C.). Nuclear Sci. and Eng., 12: 348-58(Mar. 1962).

Buckling measurements of 42 lattices of natural uranium 1-in. rods in heavy water were made in an exponential facility at two moderator purities. The fuel assemblies were single rods and clusters of 3, 7, and 19 rods. Lattice pitches varied from 3.00 to 21.59 in. A comparison was made between the bucklings that were measured in the exponential facility and those that were obtained from critical measurements. On the basis of a constant radial buckling for the exponential, systematic differences between the exponential and critical measurements were noted. Possible causes of these differences were discussed. Changes in buckling produced by changes in moderator purity were also given. (auth)

12685 ENGINEERING CONSIDERATIONS FOR REMOTE REFABRICATION OF EBR-II FUEL ELEMENTS. A. B. Shuck and J. E. Ayer (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 12: 398-404(Mar. 1962). (ANL-FGF-272)

The development of remote-control methods for manufacturing EBR-II fuel elements is influenced by many interacting factors. Radiation levels within the process cell are predicted to range from 10^3 to 10^7 rad per hour. Radiation damage to organic lubricant, electrical insulations, elastic seals, and protective coatings precludes the use of many standard machine components. Heat generated in the fuel by absorbed radiation makes forced cooling necessary in many operations. Oxygen must be excluded from all operations in which the fuel is exposed. Equipment must be designed for remote maintenance and component replacement within the limitation of available manipulators. The EBR-II fuel consists of fissium alloy pins, sodium-bonded in stainless steel tubes. Precision casting is chosen as the basis for refabricating the fuel pins. Remote-control equipment is developed to cast, assemble, and inspect the EBR-II fuel elements. Radiation resistant, plug-in machine components are developed to give reasonable life expectancy and to allow remote maintenance and replacement. (auth)

12686 EQUIPMENT FOR REMOTE INJECTION CASTING OF EBR-II FUEL. H. F. Jelinek and G. M. Iverson (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 12: 405-11(Mar. 1962). (ANL-FGF-273)

Precision injection casting is a method suitable to produce semifinished fuel pins. It is adapted to the remote refabrication of EBR-II fuel. Inert gas pressure is used to force molten fuel alloy into thoria-coated, precision-bore, high silica glass molds. During EBR-II, Core I production, 16,000 fuel castings are produced in batches of 120 using an experimental injection casting furnace. The specified weight, diametral tolerance, surface finish, and internal soundness specifications are successfully met. Remote-control equipment is designed from experience gained during Core I production. (auth)

12687 EQUIPMENT FOR THE REMOTE DEMOLDING, SIZING, AND INSPECTION OF EBR-II CAST FUEL PINS. N. J. Carson, Jr. and S. B. Brak (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 12: 412-18(Mar. 1962).

A semiautomatic, radiation-resistant machine is developed for the remote manufacture and inspection of EBR-II fuel pins from injection castings. Castings are stripped from Vycor molds by a device that breaks the molds. Fuel pins are cut from castings by shearing and

are inspected. An air gage, balance, length comparator, and eddy current probe provide progressive diameter, weight, length, and internal quality signals. These signals are fed into a computer that gives digital indications of diameter, weight, length, volume, and density, plus an internal quality trace. The accuracy of diameter, weight, and length measurements is 0.0002 in., 0.1 gm, and 0.01 in. respectively. (auth)

12688 LEAK TESTING OF EBR-II FUEL RODS. A. P. Grunwald (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 12: 419-23(Mar. 1962).

A system was developed that used pressure decay in a miniature pressure chamber as a measure of weld leakage. Analysis of pressure decay rate permitted determination of leak size. Spurious signals resulting from leakage of the test system produced an abnormal ultimate test chamber pressure. These were readily differentiated from fuel rod leaks. The sensitivity of the tests was approximately 5×10^{-6} standard cubic centimeters of helium per second. Higher sensitivity could be obtained. The influence of vapor contamination of leak capillaries was investigated and correlated with surface tension phenomena. The test was successfully applied to a variety of fuel elements and incapsulated specimens with small internal void spaces. (auth)

12689 ASSEMBLING, SODIUM BONDING, AND BOND TESTING OF EBR-II FUEL RODS. T. C. Cameron and N. F. Hessler (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 12: 424-31(Mar. 1962). (ANL-FGF-276)

Processing of the EBR-II fuel rods led to the development of sodium loading, welding, weld inspection, bonding, and bond inspection techniques. Devices such as capacitance discharge welder, pressure-type leak detector, impact bonder, and nondestructive eddy current circuitry were employed. These techniques were utilized during the manufacturing of the first core loading or were developed from the experience gained on that production run. (auth)

12690 TECHNOLOGY, ENGINEERING AND SAFETY. VOLUME 3. C. M. Nicholls, ed. Progress in Nuclear Energy. Series IV. New York, Pergamon Press, 1960. 466p.

Fifteen papers are presented on such topics as chemical and mechanical engineering research and development, design and operation of equipment and plant, and chemistry of reactors. The influence that health physics exerts on the design and operation of process plants and reactors is also covered. The inclusion of several reviews on aspects of criticality also falls within this volume. The volume contains four chapters made up of seventeen papers. Separate abstracts have been prepared for sixteen papers; one was previously abstracted in NSA. (N.W.R.)

12691 GAS BEARING FOR COMPRESSORS IN GAS-COOLED REACTORS. S. Whitley (United Kingdom Atomic Energy Authority, Capenhurst, Ches., Eng.). Progr. in Nuclear Energy, Ser. IV, 3: 3-28(1960).

The design of compressors for use in gas-cooled reactors is considerably simplified if gas bearings are used. The results of the research on gas bearings by the UKAEA are summarized. The load capacity and vibration characteristics of both hydrodynamic and hydrostatic bearings were measured and, from the results, general design methods were developed. The most useful machines employ hydrodynamic bearings; hydrostatic operation is at present limited to starting and stopping periods. (auth)

12692 SPECIAL PUMPS FOR NUCLEAR POWER PLANTS. A. F. Erwin (Allis Chalmers Mfg. Co., Milwaukee). Progr. in Nuclear Energy, Ser. IV, 3: 29-39 (1960).

The problems affecting main coolant pumps for the current types of nuclear power plants are discussed; suitable types of pumps and drives for each type of plant are described with a summary of the advantages and disadvantages of each. (auth)

12693 STEAM AS A REACTOR COOLANT—A CRITICAL ASSESSMENT. J. G. Collier (Atomic Energy Research Establishment, [Harwell, Berks, Eng.]). Progr. in Nuclear Energy, Ser. IV, 3: 43-64(1960).

The most important advantage of steam over other coolants is its possible direct use in a condensing turbine after being superheated in the reactor. Of the reactor systems discussed, that using heavy water as moderator appears to afford the best chance of developing a working unit and also the best potential for further improvement. Units employing light water and graphite as moderator also appear feasible. A number of steam cycles are described in detail with emphasis on those which require no moving items in the primary circuit other than water feed pumps. Steam is decidely better thermodynamically as a coolant than carbon dioxide. The high specific heat allows good heat transport with lower mass flowrates and smaller more compact piping systems than with other gas cooled units. However, at high temperature and pressure, it is a highly corrosive oxidizing fluid and its compatibility with reactor materials is discussed in detail. Uranium dioxide would appear to provide a suitable fuel material. Graphite appears to be incompatible, certainly above 600°C, but beryllia may be suitable up to 800°C. Stainless steels are the only suitable canning materials for use in superheating regions, though Zircaloy II would be satisfactory up to 350°C and could be used in steam generating zones. The induced radioactivity and the radiation chemistry of steam are not considered likely to present major obstacles to the development of the system. (auth)

12694 REACTIONS BETWEEN FUEL ELEMENTS AND GASEOUS COOLANTS. J. E. Antill and P. Murray (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Progr. in Nuclear Energy, Ser. IV, 3: 65-86(1960).

The reactions between coolants and fuel element materials of interest to gas cooled reactors are reviewed. (auth)

12695 THERMAL STRESSES IN FUEL ELEMENTS. J. P. Ellington and L. M. Wyatt (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Progr. in Nuclear Energy, Ser. IV, 3: 87-110(1960).

Equations are derived for the elastic stresses in simple geometries representative of fuel elements, particular attention being given to transient temperatures, and to a material, such as uranium dioxide, with a temperature dependent thermal conductivity. Attention is then given to the influence of creep and stress relaxation, and the problem of thermal stress fatigue. Temperature cycling is then shown to lead to accelerated creep rates in uranium under low stresses, and to thermal ratcheting in fuel element assemblies. (auth)

12696 FACTORS AFFECTING THE DENSITY OF SINTERED AND HOT PRESSED BERYLLIA. D. T. Livey, N. Brett, I. Denton, and P. Murray (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Progr. in Nuclear Energy, Ser. IV, 3: 111-34(1960).

The properties of beryllia formed by decomposition of $Be(OH)_2$ are examined. At low temperatures (500°C) the oxide formed has high surface area (≈ 116 m^2/g) associated with small crystallite size. The surface area drops rapidly with increase in temperature (≈ 10 m^2/g at 1400°C) causing

changes in particle size, particle shape and particle size distribution. These changes affect the pressing and sintering and hot pressing properties of the oxide powder. Comparison is made between the cold pressing and sintering behavior of "British" and "American" oxides and the influence of purity, calcination temperature and cold pressed density is considered. American data show that oxide containing ≧ 0.15 w/o of impurity elements such as magnesium, silicon and aluminum will sinter readily. Highly pure American oxide (0.03 w/o impurity elements) and the British oxide do not readily sinter to high density. Intimate dispersion of magnesia in these oxides markedly improves the sintering behavior and is more effective than the addition of a fluxing agent e.g. CaO, added by mixing dry powder particles. Calcination temperature (800-1100°C) of the powder has a marked effect on the density of sintered compacts. As the calcination temperature is increased or the powder treated by grinding, the sintered density of compacts is less affected by alteration of the pressed density. Improvement in hot pressed density is obtained by addition of CaO or MgO or by control of the calcination temperature. Grinding of the oxide to give a powder of high packing density, followed by hot pressing at 1700°C gives a density of 2.98 g/cc. (auth)

12697 THE METALLURGICAL PROPERTIES OF BISMUTH SOLUTIONS AND SLURRIES. G. W. Greenwood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Progr. in Nuclear Energy, Ser. IV, 3: 135-59(1960).

The use of fissile material dispersed in liquid bismuth in solution or as a slurry and of fertile material as a slurry are proposed. The metallurgical properties of such systems are described. Relevant basic information and recent experimental work and its interpretation are reviewed to assess the probable behavior of these systems under reactor conditions. (auth)

12698 PLANNING FOR CONTROL OF CRITICALITY EMERGENCIES. Hugh F. Henry (Oak Ridge Gaseous Diffusion Plant, Tenn.). Progr. in Nuclear Energy, Ser. IV, 3: 206-27(1960).

Some of the basic factors and considerations are outlined for planning to meet emergency conditions resulting from an accidental criticality excursion with fissionable material which is expected to remain subcritical during its normal operation; no attention is paid to problems of reactor runaway or to other types of failure wherein criticality is attained or expected. In these cases, it is assumed that specific plans, including shielding were made for personnel radiation protection during the period of criticality. Normal operations in experimental criticality facilities wherein personnel are similarly protected during the period of criticality are also excluded. It also includes some practical suggestions for emergency action as well as quantitative analyses of potential problems. The technical criteria upon which practical nuclear safety is based are not discussed, nor are the administrative steps which may be taken to prevent a criticaltiy accident. (auth)

12699 THE CRITICALITY OF HOMOGENEOUS SOLUTIONS AND MIXTURES. I. THE CRITICALITY OF URANIUM-WATER SYSTEMS. M. A. Perks (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Progr. in Nuclear Energy, Ser. IV, 3: 228-43(1960).

A comparison of two-group diffusion results with experimental data on spherical homogeneous uranium-water systems is made. Using extrapolation lengths derived from this comparison, predictions are made of the critical dimensions of infinite cylinders and slabs for all H/U ratios using the equal buckling conversion. (auth)

12700 THE CRITICALITY OF HOMOGENEOUS SOLUTIONS AND MIXTURES. II. THE CRITICALITY OF PLUTONIUM-WATER SYSTEMS. M. A. Perks, F. R. Charlesworth, and D. E. J. Thornton (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Progr. in Nuclear Energy, Ser. IV, 3: 244-52(1960).

A correlation of existing experimental data on the criticality of plutonium metal-water mixtures was made. The gap in data between effective plutonium densities of 0.1 g/cm^3 and 19.6 g/cm^3 was filled in on the basis of reasonable assumptions as to the shape of the curves. This derived basic data for spherical masses and volumes was extended by a combination of empirical methods and one-group buckling equations to the estimation of cylindrical and slab critical dimensions. Some suggestions for an experimental program to help fill in the uncertain parts of the curves are made. (auth)

12701 NEUTRON INTERACTION IN FISSILE ASSEMBLIES. A. F. Thomas and R. A. Scriven (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Progr. in Nuclear Energy, Ser. IV, 3: 253-91 (1960).

Existing methods for assessing the degree of criticality of an array of interacting fissile units are reviewed from a practical viewpoint. Emphasis is placed upon those methods which rely mainly upon direct experimental evidence and special reference is made to the interaction parameter method. (auth)

12702 SOME SIMPLE MATHEMATICAL MODELS FOR CRITICALITY PROBLEMS. R. T. Ackroyd and J. M. Ball (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Progr. in Nuclear Energy, Ser. IV, 3: 292-323(1960).

Some simple models for criticality problems are reviewed. The emphasis is on fast systems with moderating reflectors. Albedo and multigroup albedo models for fast cores with moderating reflectors are described. Comparisons with experiment are made for U^{235} and Pu^{239} cores with reflectors of water and graphite. A model for calculations on the interaction of mixed assemblied of fast and thermal cores is described and results are compared with experiment. An outline is then given of some unusual models under development. Preliminary results are encouraging. A generalization of diffusion theory takes into account the size of the system. Two novel models for reactor calculations are described—the shell and the neutron traffic model. A composite model based on generalized diffusion theory and the neutron traffic model is then described. (auth)

12703 STORED ENERGY IN IRRADIATED GRAPHITE. J. H. W. Simmons (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Progr. in Nuclear Energy, Ser. IV, 3: 327-47(1960).

A review is given of published results on the accumulation and release of stored energy with respect to their application to the conditions in a graphite moderated reactor. A brief account is also given of certain other aspects of irradiation damage in graphite. Results show that when graphite is irradiated its internal energy is increased, this additional or stored energy results from broken bonds and lattice strains. Under certain conditions enough stored energy can be accumulated to cause a considerable rise in temperature were it all released. (N.W.R.)

12704 SOURCES AND CONTROL OF RADIOACTIVE MATERIALS IN GASEOUS EFFLUENTS FROM NUCLEAR REACTORS AND PROCESSING PLANTS. B. H. Hamling

(Union Carbide Nuclear Co., Tuxedo, N. Y.). Progr. in Nuclear Energy, Ser. IV, 3: 348-68(1960).

The toxic nature, sources, properties, safe handling, and disposal of stable and radioactive airborne particulates are discussed and outlined. A measure of relative toxicities of radioactive and non-radioactive materials is given by comparing the maximum permissible air concentrations of various substances on a mass basis. Methods of air and gas cleaning are described for the gaseous effluents along with sampling and monitoring methods. The operational characteristics of air cleaning equipment are also given. (N.W.R.)

12705 REACTOR EMERGENCY SHUTDOWN EQUIPMENT. I. REACTOR SAFETY DEVICES. N. E. Huston, S. H. Fitch, and A. J. Saur ([Atomics International, Canoga Park, Calif.]). Progr. in Nuclear Energy, Ser. IV, 3: 369-88(1960).

The development status, general requirements, and characteristics of various safety devices for specific reactor types are discussed. The concepts discussed and the results to date offer the promise that self-contained safety devices can be developed which will provide additional safety in reactor plants. Application to power reactors will require more development, but research reactors can utilize effective safety devices in the immediate future. (N.W.R.)

12706 REACTOR EMERGENCY SHUTDOWN EQUIPMENT. II. DEVELOPMENT OF AN INTERNAL SAFETY FUSE FOR NUCLEAR REACTORS. Stephen N. Stilwell (General Electric Co., Cincinnati). Progr. in Nuclear Energy, Ser. IV, 3: 389-444(1960).

The feasibility of a safety fuse device to control a reactor excursion was investigated. Studies were performed on fuse configurations, types of propellants and poisons, poison retention in the reactor, and types of triggers. Dynamic tests on fuses showed that any runaway expected could be controlled. (auth)

12707 AN AQUEOUS HOMOGENEOUS ZERO-ENERGY SUSPENSION REACTOR—I. EXPERIMENTS WITH A SUBCRITICAL REACTOR, IN WHICH AN AQUEOUS SUSPENSION OF UO_2 PARTICLES IS CIRCULATING. J. A. H. Kersten (Naamloze Vennootschap tot Keuring van Electrotechnische Materialen, Arnhem, Netherlands). Reactor Sci. and Technol., J. Nuclear Energy, Pts. A & B, 16: 15-27(Jan. 1962).

Measurements on source multiplication and neutron flux variations (reactor noise) were used to investigate rheological and reactor physical properties of an aqueous homogeneous subcritical reactor, in which a suspension of UO_2 particles is circulating at room temperature. It was shown that both the colloid chemical properties of the suspension and the hydrodynamical conditions inside the core vessel have a strong influence on the behavior of the reactor at steady operation. Interesting results were also obtained under abnormal operating conditions. The effective delayed neutron fraction was measured as a function of the circulating velocity and the result appeared to be in agreement with theoretical considerations. (auth)

12708 AN AQUEOUS HOMOGENEOUS ZERO-ENERGY SUSPENSION REACTOR—II. ANALYSIS OF THE NEUTRON FLUX FLUCTUATIONS IN AN AQUEOUS HOMOGENEOUS SUBCRITICAL REACTOR WITH CIRCULATING UO_2 PARTICLES. R. Cenerini (Naamloze Venootschap tot Keuring van Electrotechnische Materialen, Arnhem, Netherlands). Reactor Sci. and Technol., J. Nuclear Energy, Pts. A & B, 16: 29-31(Jan. 1962).

The neutron flux noise in the KEMA subcritical assembly was analyzed by autocorrelation techniques. When a stable suspension was used, the oscillations showed smaller amplitude than with the unstable suspension. With the latter, characteristic periods of 8 and 16 sec were found. With the stable suspension only the 16 sec period was dominant. (auth)

12709 AN AQUEOUS HOMOGENEOUS ZERO-ENERGY SUSPENSION REACTOR—III. MEASUREMENT OF THE FISSION RECOIL SEPARATION EFFECT IN AN AQUEOUS FUEL SUSPENSION USING A HOMOGENEOUS SUBCRITICAL REACTOR ASSEMBLY. T. Markestein and Th. Van der Plas (Naamloze Vennootschap tot Keuring van Electrotechnische Materialen, Arnhem, Netherlands). Reactor Sci. and Technol., J. Nuclear Energy, Pts. A & B, 16: 33-7(Jan. 1962).

The fission recoil separation effect was measured by determining the distribution of iodine, yttrium, and rare earths over the solid and the liquid of an aqueous fuel suspension. The separation effect depended on both the colloid chemical condition of the suspension and the hydrodynamical conditions in the core vessel. In one particular case agreement was found between the experimental results and calculations based on the particle size distribution. Disagreement in another case could be explained by local increases of concentration caused either by flocculation or the flow pattern in the vessel. (auth)

12710 AN AQUEOUS HOMOGENEOUS ZERO-ENERGY SUSPENSION REACTOR—IV. THE MEASUREMENT OF THE COLLOID CHEMICAL STABILITY OF SUSPENSIONS. J. Kalshoven (Naamloze Vennootschap tot Keuring van Electrotechnische Materialen, Arnhem, Netherlands). Reactor Sci. and Technol., J. Nuclear Energy, Pts. A & B, 16: 39-41(Jan. 1962).

Sedimentation analysis is a well-known method for obtaining the particle size distribution of a powder. If the particles flocculate during this analysis, i.e. if the suspension is colloid chemically unstable, the measurement results in a wrong size distribution. Therefore it was possible to use this method to get an insight into the stability of a suspension by comparison of the particle size distributions that were obtained under different conditions. (auth)

12711 THE EFFECTS OF BERYLLIA REFLECTOR ELEMENTS ON A HIGHLY ENRICHED LIGHT-WATER MODERATED REACTOR. P. N. Cooper, W. M. Cooper, K. Firth, and A. J. Salmon (Associated Electrical Industries Ltd., Aldermaston, Berks, Eng.). Reactor Sci. and Technol., J. Nuclear Energy, Pts. A & B, 16: 43-4(Jan. 1962).

The performance and use of beryllium oxide reflector elements are described with respect to improvements made in a water moderated reactor utilizing the elements. Since beryllia does not absorb neutrons as markedly as water it may be used for filling the vacant spaces in the lattice plates, thereby giving the neutron currents more facility. Since beryllia is also a better reflector than water, there will also be a decrease in critical mass, hence, increasing the actual radiation intensities in the core. Results are given for a subcritical reactor showing the comparisons with and without beryllium oxide reflector elements. (N.W.R.)

12712 BUILDING MATERIALS AND POWER FUELS FOR NUCLEAR REACTORS. Karl Kummerer (Kernforschungszentrum, Karlsruhe, Ger.). Tech. Überwach., 2: 285-90(Aug. 1961). (In German)

Discussion is given on nuclear fuel and breeder materials, moderators, neutron absorbers and screening materials, coolants and protective gases. Structural

materials, their qualities, suitability, and behavior under particular reactor conditions are also considered. (auth)

12713 IMPROVEMENTS IN NUCLEAR REACTORS. John David Dell and John Roger Scrivener Kistruck (to Babcock & Wilcox Ltd.). British Patent 890,523. Mar. 7, 1962.

A restraint garter is designed for stabilizing the cores in graphite-moderated, gas-cooled reactors. The garter includes stays for application to the respective sides of the core, balance beams for connecting the ends of the stays to form a ring, a ring of linkwork encircling the stays, and a series of bellows connected therein. When the coolant is pressurized, the differential pressure causes the bellows to urge the stays against the sides of the core and thus counteract the coolant pressure in the core channels. (D.L.C.)

12714 IMPROVEMENTS IN OR RELATING TO CONTROL ARRANGEMENTS FOR NUCLEAR REACTORS. Geoffrey Frank Bennett and Maurice Lindfield (to General Electric Co., Ltd.). British Patent 890,572. Mar. 7, 1962.

A reactor control arrangement is designed in which the control rod normally is supported above the reactor core by an electromagnet but has latching means releasable to cause the rod to drop into the core for emergency shutdown. The releasing means of the latching means are bellows adapted to release the control rod when abnormal temperature and pressure conditions occur in the core. (D.L.C.)

12715 PROTECTIVE DEVICE FOR NUCLEAR REACTORS. Charles Theodore Greeson (to A. Reyrolle & Co., Ltd.). British Patent 890,661. Mar. 7, 1962.

A protective device is designed for the shutdown of a gas-cooled reactor in the event of overheating. The device comprises a permanent magnet whose poles are shunted by a magnetic shunt made of a ferromagnetic material whose Curie point coincides with the temperature at which the device is to operate. Automatic means responsive to the change in the magnetic flux in the shunt when heated above its Curie point is provided to cause shutdown of the reactor. (D.L.C.)

12716 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Frank Butler (to United Kingdom Atomic Energy Authority). British Patent 891,179. Mar. 14, 1962.

The common practice of filling the space between the fuel member and the sheath with helium at up to 250 mm Hg pressure entails the possibility of air leak through the temporary seal over the open end prior to final sealing with an end cap. This problem, which can result in hot spots from the nitrogen overpressure at high temperatures, is solved by employing a helium–oxygen mixture at atmospheric pressure as the filling gas, sealing the sheath, and heating the fuel element so that the oxygen is taken up by the fuel member. The gas mixture is preferably 5 vol % helium and 95 vol % oxygen. (D.L.C.)

12717 IMPROVEMENTS IN OR RELATING TO CONTROL VALVE SYSTEMS FOR MULTICHANNEL FLOW CIRCUITS. Murray Vincent Wilson (to Plessey Co., Ltd.). British Patent 891,299. Mar. 14, 1962.

A valve control system for multichannel flow circuits is designed for monitoring coolant from reactor fuel channels for fission product activity. In this system, the channels are arranged into rows and columns, and a first valve and a second valve are provided in each channel for controlling fluid flow therein. All of the first valves of any one row of channels and all of the second valves of any one column of channels are actuated by first and second common actuating means, respectively. Thus, any faulty channel may be detected rapidly by connecting the columns and rows of channels sequentially with two detectors. Two embodiments of the system are described, one operated mechanically and the other operated with pistons. (D.L.C.)

12718 IMPROVEMENTS IN OR RELATING TO THERMAL INSULATION. Thomas Ferlie Dryden and John Matthewson Miller (to Babcock & Wilcox Ltd.). British Patent 891,353. Mar. 14, 1962.

A thermal insulation panel is designed for application to the internal surfaces of reactor pressure vessels. The panel includes a layer of expanded metal sheeting which has a poor thermal conductivity between its opposite faces and which is attached to a metal sheet. Barrier means is provided to prevent convection in the panel. (D.L.C.)

12719 IMPROVEMENTS IN OR RELATING TO THERMAL INSULATION. John Matthewson Miller and Thomas Ferlie Dryden (to Babcock & Wilcox Ltd.). British Patent 891,354. Mar. 14, 1962.

A thermal insulation is designed for covering the interior surface of a reactor pressure vessel. The insulation comprises a plurality of panels of expanded metal sheeting as described in British Patent 891,353 and held in position on the pressure vessel surface by strips of metallic insulating material. Gaps are left between the panels to accommodate thermal expansion or contraction of the pressure vessel. (D.L.C.)

12720 ENERGY ABSORBING DEVICES FOR ARRESTING BODIES ON IMPACT. Peter McGregor Ross and Brian Oldfield Dowsett (to C. A. Parsons & Co., Ltd.). British Patent 891,525. Mar. 14, 1962.

An energy-absorbing device is designed for arresting a reactor control rod should its suspension means fail and it fall under gravity. The device comprises at least one roll of dimpled sheet attached in a casing to the lower end of the control rod and arranged to crumple in the direction of its axis on impact. (D.L.C.)

12721 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR CHARGE CHUTES. William Commander (to English Electric Co., Ltd.). British Patent 891,708. Mar. 14, 1962.

A charge chute is designed for moving fuel elements into and out of a reactor through access tubes. The chute comprises a tubular guide member which is inserted in an access tube, an articulated portion at the inner end of the member which is arranged to cooperate with any one of several fuel channels, actuating means at the outer end of the member which is to align the articulated portion with any desired channel, and inner and outer radiation shields. The outer shield has cooling ducts, and the inner shield comprises one or more plugs. (D.L.C.)

12722 CONSTRUCTION OF THE DISTRIBUTING AND COLLECTING VESSELS FOR THE COOLING MEDIUM IN HETEROGENEOUS NUCLEAR REACTORS. Ragnar Liljeblad and Kristian Dahl Madsen (to Allmanna Svenska Elektriska Aktiebolaget). U. S. Patent 3,026,256. Mar. 20, 1962.

A distributing- and collecting-vessel design for heterogeneous reactors of the pressure tube type and having both vessels on one side is presented which eliminates radial tension differences in a simple way. The cover and bottom of the distributing vessel for the incoming cold coolant are held together by bushings inserted in openings for the fuel elements, and the collecting vessel for the outgoing hot coolant is supported by the bushings in the distributing vessel and coated inwardly with heat insulation. (D.L.C.)

12723 ARTICULATED SYSTEM FOR CONTROL OF ASSEMBLY OF FUEL RODS AND NEUTRON REFLECTOR PANELS. André Huet. U. S. Patent 3,026,258. Mar. 20, 1962.

A reactor comprising a geometrical array of fuel rods which can be gathered together or spread apart is designed with moderating or reflector panels surrounding the array and arranged to move simultaneously with the array. Each panel is attached to one of the rods of the row extending alongside the panel, while the other rods are left free to slide along the panel. (D.L.C.)

Power Reactors

12724 (AI-P-1155) HALLAM NUCLEAR POWER FACILITY PREOPERATIONAL TEST COMPLETION REPORT; DRY CRITICALITY. H. C. Kempt and W. P. Corcoran (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 24, 1962. Contract AT(11-1)-GEN-8. 49p.

A dry criticality test was carried out to determine the minimum critical mass of the HNPF Core without sodium. A subcritical calibration of the central control rod was performed and the relative reactivity worths of the inner ring of six control rods were determined. The extrapolated critical loading for the various plots after each incremental fuel loading with all rods out is shown. A tabulation is presented of multiplication data taken throughout the dry critical test. In order to find the relative integral reactivity worth of the central control rod in the dry critical loading, subcritical multiplication data were obtained. The test completion criteria as stated in the test procedure were met. (M.C.G.)

12725 (AI-P-1163) HALLAM NUCLEAR POWER FACILITY, PREOPERATIONAL TEST INTERIM REPORT; DRY EXCESS LOADING. H. C. Kempt and W. P. Corcoran (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 25, 1962. Contract AT(11-1)-GEN-8. 33p.

A test to obtain data for use in determining the reactivity worth of Na in the Hallam reactor core is described. The test is designed to obtain information on the dry temperature coefficient of reactivity and to train operators. An evaluation of results is included. (J.R.D.)

12726 (ANL-6162) EBWR REACTOR PRESSURE VESSEL REVISIONS FOR INSTRUMENTATION AND INCREASED STEAM OUTPUT. T. L. Kettles and N. Balai (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-Eng-38. 58p.

The procedures developed and utilized for the addition of connections to the EBWR pressure vessel after three years of intermittent operation at the 20-Mw(t) design heat output are described. Major nozzle connections to the pressure vessel were made during two separated periods and under different conditions of vessel content. The details of the conversion are discussed under the following topics: nozzle design, preparations, and nozzle installation. Diagrams and photographs are included. Radioactive particulate material transport and trapped radioactive particulate matter are discussed. (M.C.G.)

12727 (ANL-6525) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, FEBRUARY 1962. (Argonne National Lab., Ill.). Feb. 1962. Contract W-31-109-eng-38. 66p.

Progress is reported on EBWR, BORAX-V, and development of liquid metal cooled reactors including EBR-I and -II. Developments in general reactor technology are reported in sections on physics, fuels, components, materials, engineering, and chemical separations. Other research and development is reported in advanced systems and nuclear safety. (J.R.D.)

12728 (APAE-108) ARMY PWR SUPPORT AND DEVELOPMENT PROGRAM. SECOND HALF-YEAR SUMMARY REPORT, APRIL 1, 1961–SEPTEMBER 30, 1961. (Alco Products Inc., Schenectady, N. Y.). Dec. 15, 1961. Contract AT(30-1)-2639. 147p.

Results of a study of radiation damage in SM-1 reactor vessel indicated that replacement of the vessel is possible but impractical because of health physics problems. An evaluation of PH steel components revealed that 17-4 PH steel was used for several years in control rod drives without incident. A specification for 17-4 PH procurement was developed. Data and information concerning the performance of SM-1 Core I, SM-1 Core I rearranged and spiked, SM-1 Core II, PM-2A Core I, and SM-1A Core I, are presented. Developments on replacement cores are also reported along with results of primary system performance analysis. A study of methods for improved activity control in primary systems was continued. Resulting data from an analysis of reactor pressure vessels during operating life are included. (J.R.D.)

12729 (BNL-5830) SETTLED BED FUEL REACTORS. L. P. Hatch, W. A. Robba, J. R. Powell, W. H. Regan, L. Green, and K. C. Hoffman (Brookhaven National Lab., Upton, N. Y.). Nov. 1961. 38p.

Presented at the 46th National Meeting of the American Institute of Chemical Engineers, Los Angeles, California, February 4-7, 1962.

Engineering design considerations are presented for a group of nuclear reactors using particulate fuel capable of being fluidized in liquid media. Reactor designs considered include: UO_2-sodium-graphite thermal reactors; U-233-Li-7-BeO thermal breeder; UO_2-PuO_2-fueled-sodium cooled; and UC-PuC fueled-sodium cooled. Heat transfer and fluid dynamics are discussed for both the axial and radial flow cases. (B.O.G.)

12730 (CEND-150(Pt. III)) ADVANCED INDIRECT CYCLE WATER REACTOR STUDIES FOR MARITIME APPLICATIONS. PART III. ANALOG SIMULATION OF REACTOR PLANT TRANSIENTS. Final Report. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Oct. 23, 1961. Contract AT(30-1)-2709. 55p. (NYO-9949(Pt. III)).

Operating characteristics of a 2100- and a 1300-psi self-pressurized reactor plant for maritime application are presented based on analog computer studies. Steam demand and reactivity transients are simulated to show the influence of moderator density and Doppler reactivity coefficients. Special attention is given to the influence of surge-induced compression of the reactor steam dome during decreasing steam demand transients. Compression of the steam dome under various conditions ranging from near adiabatic processes to equilibrium processes were examined. The major features of the self-pressurized reactor plant are presented showing that the inherent self-control of a conventional pressurized water reactor plant is maintained and that the Doppler effect and small amount of boiling in the core provide a strong stabilizing influence on transient response. It is also shown that, although load following capability of the self-pressurized plant is not altered by the assumed mode of surge induced steam dome compression during a decreasing load, the system pressure is strongly dependent on the mode of steam dome

compression and factors such as steam dome volume. Experimental investigation of the temperature and pressure transient behavior in the steam dome of a self-pressurized system is recommended in order to make a confident selection of a minimum steam dome volume. (auth)

12731 (CEND-150(Pt.V)) ADVANCED INDIRECT CYCLE WATER REACTOR STUDIES FOR MARITIME APPLICATION. PART V. SPIKED CORE CONCEPT. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Oct. 23, 1961. Contract AT(30-1)-2709. 48p. (NYO-9949(Pt.V))

A spiked core reactor concept is described. The core is composed of small regions of intermediate enrichment UO_2 fuel, called spikes, uniformly distributed in a subcritical matrix of low enrichment UO_2 fuel. The matrix region produces the majority of the reactor's power. The concept is analyzed from nuclear, thermal-hydraulic, and economic standpoints. Core features include small reactivity control requirements, long life, and improved neutron economy. Included in the analysis is the evaluation of newly developed fuel, ZrO_2-UO_2-CaO solid solution, as fuel for the spiked regions. (auth)

12732 (CVNA-118) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD OCTOBER, NOVEMBER, DECEMBER 1961. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). 239p. Contract [AT(30-3)-222]. 154p.

Research and development progress on the Parr Shoals Power Reactor is reported. Nuclear design, pressure tube assembly development and analysis, fuel development, irradiation experiments and analysis, materials development and fabrication technique, component development, plant system development, instrumentation and control, safety analysis and evaluation, and critical experiments are discussed. (M.C.G.)

12733 (DC-59-8-22) D102A DATA BOOK, 8TH ISSUE. T. W. Schoenberger (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 29, 1959. Contract AT(11-1)-171. 513p.

Supersedes DC-58-10-159.

Design modifications effected during rebuilding of the D102A turbojet reactor after a power excursion are described. Included are revisions to moderator latching, orificing, and attachment. Modifications on the control system design to prevent recurrence of the incident are also reported. Nuclear and thermodynamic data are also included along with information on shielding, structures, accessories, remote handling, and controls. (J.R.D.)

12734 (DC-59-8-196) TEMPERATURE RESPONSE OF D-102-A2-(A) CORE COMPONENTS TO STARTUP. W. C. Powell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 24, 1959. Contract AT(11-1)-171. 40p.

Calculated temperatures of core components are shown as a function of time after reactor startup for a range of reactor powers and air flow rates. (auth)

12735 (EURAEC-80) PLUTONIUM USED AS A FUEL IN NUCLEAR REACTORS. Quarterly Report No. 3, January–March 1961. (Societe Belge pour l'Industrie Nucleaire, Brussels). Apr. 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract [027-60-7RDB]. 61p.

The various factors affecting dissolution speeds of PuO_2 and UO_2-PuO_2 mixtures were investigated. Kinetic studies of the sintering of UO_2-PuO_2 mixtures showed once more the influence of the O_2 content of argon on the sintering speed. The study with a view to producing dense and spherical grains was pursued using heating by resistance, plasma-jet, and sifting. A carburetion test by carbon was carried out on PuO_2. During the hot swaging of ceramics, a maximum was recorded in the "density-temperature" curve. In addition, densities of 94% were obtained by cold swaging. The Mo and Cr coating of spherical particles by metallization under vacuum, gave good results. The thermal expansion of UO_2 + 5% PuO_2 was measured. The TTT diagram of the Zr–Nb 10 alloy was established. Ternary additions to the Zr–Nb 15 alloy did not increase the transformation temperature appreciably. Corrosion studies in water at 300 and 350°C were carried out on alloys containing 10, 15, and 20% Nb. These alloys compared favorably with non-alloyed Zr. (auth)

12736 (EXP-NRX-5903) IRRADIATION OF DEFECTED SAP CLAD UO_2 FUEL IN THE X-7 ORGANIC LOOP. R. F. S. Robertson, A. G. Cracknell, and R. D. MacDonald (Atomic Energy of Canada Ltd., Chalk River, Ont.). Oct. 1961. 59p. (AECL-1390)

A test to determine the irradiation behavior of defected SAP clad UO_2 fuel was conducted. A specimen was irradiated in the NRX organic-cooled X-7 loop from Nov. 25 to Dec. 13, 1960, at which time the sample was removed and examined following a reactor shutdown and startup. The sheath was found to be split and the space between the fuel and sheath was filled with a hard black organic substance. It was concluded that the rupture took place simultaneously with the decrease in reactor power and an increase in gamma radiation. Other correlations of observed occurrences are made and problems associated with defected fuel in organic reactors are assessed. (J.R.D.)

12737 (GAMD-1208) A SURVEY OF CONVENTIONAL STEAM BOILER EXPERIENCE APPLICABLE TO THE HTGR STEAM GENERATORS. J. A. Paget (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Oct. 1959. Contract AT(04-3)-314. 79p.

The steam generator of a high temperature gas-cooled reactor consists of tubular heating surface inside a shell which forms part of the primary He circuit of the reactor. When a tube fails in such a steam generator, moisture in the form of steam is released into the He steam and is carried through the reactor where it will cause corrosion and mass transfer of C in the core. A paramount consideration in the design of a steam generator for a high temperature gas-cooled reactor is the prevention of tube failures. Preference, therefore, should be given to a forced circulation design. The Loeffler Boiler would be the best from this standpoint alone since only steam enters the tubes, and its circulation rate can be maintained at an adequate value to insure cool tubes regardless of load fluctuations. The next type in the order of preference would be the forced recirculation boiler, since at least the boiler tubes always have an adequate cooling flow regardless of output. The third type in order of preference would be a Sulzer Type boiler since it has a separator to remove dissolved material from the water which is comparable in efficiency to a standard boiler drum and although the flow through evaporator and superheater fluctuates with load, the Sulzer Boiler can be operated as a forced recirculation boiler at low loads. The least desirable type would be a Benson or supercritical boiler which is completely dependent on input water purity for its survival. It is not claimed that Benson or supercritical boilers should not or will not be used in the future for gas-cooled

reactors, but only that their use would be the least conservative choice from a tube failure standpoint at the present time. (auth)

12738 (HW-53319) DESIGN OF TUBULAR FUEL ELEMENTS FOR THE PRTR. J. Muraoka (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 23, 1957. Contract AT(45-1)-1350. 14p.

Specifications for dimensions and operating conditions of tubular PRTR fuel elements are presented. (J.R.D.)

12739 (IDO-16636) REVIEW OF SEVERAL MODELS FOR POWER BEHAVIOR AND REACTIVITY FEEDBACK IN REACTOR EXCURSION STUDIES. R. W. Garner (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 6, 1962. Contract AT(10-1)-205. 47p.

One of the over-all objectives of the Spert Program for reactor kinetics is to obtain, by experimental and theoretical studies, an understanding of the functional dependence of reactor kinetic behavior on various reactor parameters. A part of the program is concerned with the investigation of the inherent self-limiting response of the reactor system to large reactivity perturbations. A large portion of some analytical work performed at Spert which was reported in various quarterly reports was compiled. Work is described which was directed primarily at the development of analytical models to describe and correlate the experimental data obtained and permit some extrapolation of the data beyond present experience. Calculations of the reactivity compensated at the time of peak power were extended to include values obtained for a Clipped Exponential burst shape model and some salient features of the Two Term burst shape model were emphasized. As a result of investigating the effects of various forms of coupling between reactivity and power behavior, four correlative models are described and compared with experimental results. The qualitative accomplishments of the correlative approach to reactor dynamic behavior are pointed out as well as the shortcomings of each coupling equation. (auth)

12740 (NAA-SR-6890) DISTRIBUTION OF FISSION PRODUCT CONTAMINATION IN THE SRE. R. S. Hart (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 1, 1962. Contract AT(11-1)-GEN-8. 34p.

In the safety analysis of sodium-cooled reactors, a remaining area of significant uncertainty was the fate of various fission products that may be released to the coolant in the event of a fuel element failure; that is, the degree of their retainment in the sodium, movement to the reactor cover gas system or deposition in other portions of the primary system. During the recovery procedures following the fuel element damage that occurred at the Sodium Reactor Experiment (SRE) in July 1959, the opportunity was provided for obtaining such data on a full-scale basis. The collection and analysis of pertinent information from this incident was undertaken. Although significant fuel melting did not occur, some degree of preferential fission products volatility was involved in the relative release of the various fission products into the primary coolant. Only Xe and Kr isotopes were found in the reactor cover gas (helium). The carbonaceous particulate material, resulting from the decomposition of tetralin which leaked into the primary sodium, proved to be an effective fission product scavenger. A generally non-selective concentration of activity by this material of 10^3 to 10^4 times that of the filtered sodium was measured. The cold trap located in the primary system was effective in removing fission product contamination. Appreciable deposition of fission product contamination occurred throughout the primary piping system. A marked selectivity was evident in this process, with Sr, Ce, and Zr-Nb deposition being much greater than that of Cs or I. Although 5,000 to 10,000 curies of fission product activity were unexpectedly released to the primary sodium system, no radiological emergency of any nature occurred. Recovery operations were completed at a reasonable speed well within accepted personnel exposure limits. The same sodium is still in use during current operation of the SRE, with only Cs^{137} and possibly Sb^{125} remaining as significant, dissolved, long-lived contamination. Even these are now reduced to the same order as the Na^{22} activity ($\sim 10^{-2}$ μc/gram), and their presence should not appreciably affect future operations of the reactor. (auth)

12741 (NAA-SR-Memo-3486) FURTHER STUDIES OF NUCLEAR PARAMETERS OF THE U–Mo FUELED HALLAM NUCLEAR FACILITY. R. J. Doyas (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 27, 1959. Contract [AT-11-1-GEN-8]. 8p.

The reactor core design fueled with 10 wt % Mo–U alloy in 19-rod clusters was surveyed for ϵ ranging from 2.5 to 3.5 at.% and for fuel areas from 4.0 to 6.0 in.^{2} Changing the fuel areas was done to select a preliminary reference design to use in the initial nuclear calculations. On the basis of these results, 5.0 to 6.0 in.^{2} was chosen as the range for a further study on which an economic evaluation will be made. K_{eff} and the initial conversion ratio were plotted as functions of ϵ and fuel areas. Nuclear data for the reference case are given along with the physical conditions assumed in the survey. (auth)

12742 (NAA-SR-Memo-5182) SHIELDING ANALYSES FOR THE HNPF FUEL ELEMENT SHIELD PLUGS. S. Bergar (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 14, 1960. Contract [AT-11-1-GEN-8]. 13p.

The shielding of the HNPF fuel element shield plug was analyzed and reviewed. The direct gamma radiation penetrating the fuel plug was 0.32 mr/hr. The dose rate due to the direct penetration by fast and thermal neutrons was negligible. Gamma radiation streaming up the $\frac{1}{16}$-in. annular gap between the fuel plug and the cavity liner was 2.0 mr/hr. Fast neutron scattering up the $\frac{1}{16}$-in. gap between the teleflex cable and its conduit had a maximum value of 7 n/cm^2-sec or approximately 1.0 mrem/hr. The thermocouple conduit containing the two thermocouples and spiraling 180° through the top shield presented no radiation problem. The dose rate was about equal to that of the bulk shielding, 0.32 mr/hr. (M.C.G.)

12743 (NAA-SR-Memo-5503) IMPROVED DESIGN FOR FUEL HANDLING ON SODIUM GRAPHITE POWER REACTORS. T. F. Edziak, R. O. Crosgrove, and J. F. Stolz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [nd]. Contract [AT-11-1-GEN-8]. 13p.

Operational experience at the SRE and evaluation of alternate methods resulted in the development of an optimized fuel-handling system for the Hallam Nuclear Power Facility Reactor. Increased reliability, easier maintenance, improved safeguards, and broader flexibility are some of the characteristics of this system, which features a manually-operated, shielded cask with reactor atmosphere seals that is usable in a conventional unshielded air-atmosphere building. (auth)

12744 (NAA-SR-Memo-6581) RE-EVALUATION OF ENERGY ABSORPTION RATE IN OMR'S. D. S. Duncan (Atomics International. Div. of North American Aviation,

Inc., Canoga Park, Calif.). July 13, 1961. Contract [AT-11-1-GEN-8]. 43p.

The amount of energy absorbed by the organic coolants of the OMRE, Piqua, and OMCR reactors was calculated. Fast neutron energy deposition was determined using a modified version of the FORM code. A detailed description of the code modification is presented. A method was developed to calculate the fraction of the gamma energy produced which is absorbed by organic coolant inside the core. Gamma leakage from the core was handled using a modified version of the GRACE II code. The energy absorbed by the coolant of the OMRE resulting from fission product betas escaping a clad fuel region was calculated. The results are presented in a manner such that energy absorption rates for additional OMR-type reactors can be easily determined without having to repeat lengthy and detailed calculations. (auth)

12745 (NAA-SR-Memo-6662) RESULTS OF THE S2DR REACTOR NOISE EXPERIMENT. R. L. Randall (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 18, 1961. Contract [AT-11-1-GEN-8]. 26p.

The value of (β/l^*) (the ratio of β effective to the average prompt neutron lifetime) for the S2DR was determined from measurements of the power spectral density of reactor noise signals which were obtained from an in-core BF_3 pulse chamber and a fast count rate circuit. A computed "least squares" fit to the power spectral density data indicated (β/l^*) to be 1277 ± 150 sec^{-1}. This compares favorably with the calculated value of 1275 sec^{-1}. This experiment demonstrated that a pulse chamber and a fast count rate circuit make possible the precision measurement of the high frequency reactor noise components which are present in small metal reactors. The addition of an FM tape recording system and modifications in the existing wave analyzer system will extend the applications and improve the precision of future reactor noise measurements. (auth)

12746 (NAA-SR-TDR-6540) PROPOSED REORIENTATION OF ATOMICS INTERNATIONAL ASCR PROGRAM. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 27, 1961. Contract AT(11-1)-Gen-8. 23p.

Recommendations for reorientation of certain Advanced Sodium Cooled Reactor (ASCR) research activities are presented. It is noted that implementation of a project for design and construction of a 360-Mwe SGR may occur if selected aspects of the ASCR program are reoriented toward the requirements of this specific plant. (J.R.D.)

12747 (NMI-7244) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission for the Period October 1, 1961–October 31, 1961. S. Isserow, R. W. Anderson, E. F. Jordan, W. J. Richmond, and W. L. Larson (Nuclear Metals, Inc., Concord, Mass.). Dec. 7, 1961. Contract AT(30-1)-1565. 12p.

Three tubes, fabricated with 60 mils of cladding for the restraint program, were autoradiographed. In the absence of 60-mil standards, quantitative cladding thickness measurements were not possible. However, comparison with a 30.5-mil standard and with the uniform core sections indicated that the claddings are everywhere greater than 30.5 mils and that there are no abnormally thin bands. The surfaces of the U–0.3 wt % Al–0.5 wt % Si experimental tube (No. 135) were inspected after the first etch. No serious defects were found. Further processing of the tube is being deferred until the large autoclave becomes available. For chemically recessing the HWCTR tube ends for end cap brazing, three methods, differing in orientation of the tube, are being evaluated. All methods have produced on the Zircaloy surfaces a black layer that retards wetting by the brazing alloy; means are being sought to avoid or to remove this layer. (auth)

12748 (NMI-7245) POWER REACTOR PROGRAM. Progress Report to United States Atomic Energy Commission, November 1, 1961–November 30, 1961. S. Isserow, R. W. Anderson, and W. L. Larson (Nuclear Metals, Inc., Concord, Mass.). Jan. 12, 1962. Contract AT(30-1)-1565. 12p.

Work on HWCTR end cap brazing is reported in the evaluation of a method of tube immersion in the solution used for chemical recessing of tube ends. Other work is reported on the elimination of voids in the braze layer. Means of preventing black layer formation on Zircaloy during tube end recessing is reported. Initial work was begun on the optimization of Al–Si–U alloys. (J.R.D.)

12749 (SL-1915-2) ENGINEERING EVALUATION STUDIES HEAVY WATER MODERATED POWER REACTOR PLANTS. Quarterly Progress Report, October–December 1961. (Sargent and Lundy, Chicago). Jan. 25, 1962. Contract AT(38-1)-213. 65p.

The computer program for economic optimization of D_2O power reactors is being conducted to achieve desirable designs of 300-Mwe systems. The presently used IBM-60 program is currently being rewritten for application on an IBM-704 machine. Revisions were made on programs for the purification systems and the shutdown cooling system. Work on superheated steam turbine plant costs is also reported for systems with steam pressures of 400, 600, 800, 1000, 1200, 1400, and 1500 psia. All data developed for these plants are based on 300-Mwe H_2O direct-cycle and are comparable with economic bases for the saturated steam plants. In prototype scoping, effort was devoted to selection of a D_2O-moderated reactor prototype plant concept and size. (J.R.D.)

12750 (SRO-65) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, FEBRUARY 1962. (Savannah River Operations Office, AEC). 10p.

Activities are reported in the AEC/AECL Cooperative program. Other work is reported in physics, metallurgy, engineering, heat transfer, and reactor fuel evaluation. Operation of the Savannah River Components Test Reactor is summarized, and design work on the Parr Shoals power reactor is reported. (J.R.D.)

12751 (TID-13083) ELK RIVER REACTOR VESSEL CLADDING DEFECTS. (Allis-Chalmers Mfg. Co. Nuclear Power Dept., Washington, D. C.). May 19, 1961. Contract AT(11-1)-654. 34p.

Examination of the Elk River reactor vessel after performance of the initial preoperational testing program revealed several cracks and flaws in the stainless steel welded overlay on the vessel and head flange forgings. A description is presented concerning the characteristics of these defects and their cause. Detailed repair procedures are included. (J.R.D.)

12752 (TID-14557) ECONOMIC STUDY OF NUCLEAR PROPULSION FOR AMERICAN FLAG TANKERS. (Sharp (George G.) Inc., New York and Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Nov. 1961. For Maritime Administration, Washington, D. C. Contracts MA-2686 and AT(30-1)-2824. 75p. (N-6019)

A study was conducted to compare the capital and operating costs of tanker designs with nuclear and conventional propulsion for each design. The nuclear plants selected

for the study are advanced designs of the pressurized water type. It is concluded that nuclear power for such vessels is approaching a competitive position with conventional power on long routes. Nuclear power also becomes more competitive as ship deadweight increases and as the price of oil increases. (J.R.D.)

12753 (TID-14980) HNPF PRIMARY PIPE TUNNEL LEAK TEST REPORT. C. C. Conners (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 19, 1962. Contract [AT(11-1)-Gen-8]. 18p.

Tests were made on the primary pipe tunnel of the Hallam Nuclear Power Facility to determine the leakage rate, to find minor leaks at penetrations into the tunnel, and to ascertain the structural integrity of the tunnel and of the nitrogen cooling units and associated ducting. The pipe tunnel was found to fulfill the requirements given in Supplement 4 of NAA-SR-5700 (safeguards report), namely, less than 2.1% standard volume leakage in 24 hr. (D.L.C.)

12754 (TID-15058) FEATURES OF THE SODIUM GRAPHITE REACTOR. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 29, 1961. Contract AT(11-1)-GEN-8. 16p.

The SGR is a high-performance system which offers higher thermal efficiency and a greater degree of reactor safety than any other nuclear system currently under development. Performance, safety, and economic features of the SGR are expected to keep this type of reactor in the forefront until such time as breeders can demonstrate lower fuel costs. (J.R.D.)

12755 (TID-15073) MODERN STEAM CONDITIONS FROM A 360-MWE SODIUM–GRAPHITE REACTOR. R. W. Dickinson and R. J. Beeley (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 1962. Contract [AT(11-1)-Gen-8]. 24p.

An SGR Plant is described which represents a new level in power plant performance. The key to the excellent performance of this 360-Mw plant is the UC fuel which is being tested at present. It is thought that the SGR is likely to lead in the power production field. (J.R.D.)

12756 (WAPD-T-1386) PWR-CORE 2 REACTOR AND ANALYTIC MODEL DESCRIPTION. PART II. C. A. Flanagan and W. H. Hannum (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1961. Contract AT(11-1)-Gen-14. 18p.

For Presentation at ANS Meeting, November 1961.

The analytic model used to investigate the lifetime behavior of the PWR–Core 2 is described. The basic model to describe three dimensional behavior consists of a synthesis of two dimensional radial results with one dimensional axial results. Four neutron energy groups are treated by diffusion theory in the model. The microscopic cross sections in the slowing down region are treated by a Fourier transform solution which includes all element slowing down and epi-thermal absorption. The thermal energy group constants are obtained by averaging over a flux spectrum which accounts for the high absorption of the medium, in the case of the seed regions. Regions of the reactor in which the absorption is very high and in which neutron transport corrections are necessary are treated in the diffusion theory calculations by special techniques. The heterogeneous resonance absorption integral of U^{238} in the blanket region was obtained by Monte Carlo calculations and the epi-thermal group constants used in reactor calculations were adjusted to account for the heterogeneous structure. (auth)

12757 (WCAP-1900) THERMOELECTRIC NUCLEAR FUEL ELEMENT. Final Report. G. R. Kilp, W. P. Blankenship, K. J. Gill, R. C. Goodspeed, G. Kivenson, and P. V. Mitchell (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Feb. 10, 1962. Contract AT(30-3)-500. 57p.

The results of a research and development program to determine the feasibility of an in-pile thermoelectric direct conversion reactor are summarized. The development of a suitable fuel element containing thermoelectric materials "wrapped" around the fuel is emphasized. Studies of irradiation damage, electrical measurements, preparation of uranium thermoelectric materials, and basic fabrication problems are also summarized. (auth)

12758 (WCAP-4061) CVTR PROJECT, CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., MONTHLY PROGRESS REPORT, NOVEMBER 1961. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Contract AT(30-1)-2289. 21p.

Impulse burst testing of pressure tube specimens continued using V-notched specimens. Examination of the Phase II U-tube revealed considerable crud deposits. A Zircaloy-stainless steel joint was fabricated with an Inconel sleeve and cycling tests were started. Testing of the control rod system was completed. Several of the components were examined and indicated only nominal wear. The energy absorber, which is intended to absorb the energy of the falling control rod in the event the dashpot is ineffective or the drive line severs, did not function perfectly; however, the control rod remained in satisfactory condition. Examination of approximately 20% of the fuel rods revealed that approximately 1% of the fuel rods had corroded at the welded ends. (auth)

12759 (YAEC-184) THE STARTUP EXPERIMENT PROGRAM FOR THE YANKEE REACTOR. J. M. Gallagher, Jr., H. W. Graves, Jr., D. Hunter (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh) and J. E. Howard (Yankee Atomic Electric Co., Boston). June 1961. Contract AT(30-3)-222, Subcontract No. 1. 125p.

A series of experiments was performed with the Yankee Reactor Plant to determine the characteristics of the reactor and primary system following initial criticality. These included reactor physics experiments, control rod drive tests, and primary system transient response studies. The experiments are described and the results are evaluated from the standpoint of previous analysis. Agreement with calculations was found to be very good. (auth)

12760 THE ESSENTIAL CHARACTERISTICS OF THE PRODUCTION COSTS OF ELECTRONUCLEAR ENERGY: THE PLANTS. Mario Bruni. Econ. intern. fonti energia, 5: 417-49(May-June 1961). (In Italian)

The term "plant costs" means the sum of all the charges from the acquisition of all the stationary and movable property, materials, and accessories which are necessary for the fulfillment of the productive process and for its maintenance. The cost of a nuclear power plant is discussed, and the relationship between plant cost and the cost of nuclear power is indicated. The increase of the plant cost with reactor output is discussed in conclusion. (J.S.R.)

12761 THE CONDITIONS OF NUCLEAR POWER IN MEETING DAILY AND YEARLY LOAD DIAGRAMS. Franco Castelli. Econ. intern. fonti energia, 5: 451-71(May-June 1961). (In Italian)

The utilization of load diagrams in estimating daily and yearly power needs are briefly reviewed, and their components are indicated. The engineering characteristics in the start-up and operation of a reactor, with respect to meeting power needs, are described. In conclusion, eco-

nomic considerations on meeting power needs with power reactors are given. (J.S.R.)

12762 PROBLEMS OF CONVENIENCE IN THE SELECTION OF VARIOUS REACTOR TYPES. Paolo Simonini. Econ. intern. fonti energia, 5: 471-84(May-June 1961). (In Italian)

Economic factors affecting the selection of reactor types are reviewed. Emphasis is placed on the financial charges relative to the investment and on the fuel costs. These factors are discussed with respect to conditions in which high plant costs often correspond to lower fuel cycle costs. (J.S.R.)

12763 FURTHER PROBLEMS OF CONVENIENCE IN THE SELECTION OF VARIOUS TYPES OF REACTORS. Leonardo Biondi. Econ. intern. fonti energia, 5: 485-90 (May-June 1961). (In Italian)

In order to compare various reactor types for suitability, they must be considered under equal conditions. The difficulties in determining equal conditions are indicated. Possible problems in the selection of natural uranium, enriched uranium, and thorium cycles are considered. The effect that continued experimentation will have on the future selection of reactors is discussed. (J.S.R.)

12764 KILOWATT-HOUR PRICE OF A NUCLEAR POWER PLANT. EFFECT OF THE VARIATION OF ITS COMPONENTS. Virgilio Soria Pérez (Instituto Nacional de Industria, [Madrid]). Energia nuclear (Madrid), 5: 22-3(July-Sept. 1961). (In Spanish)

The mutual effects which, under given conditions, exist between the variations of the parameters which determine the price of the kwh produced in a nuclear power plant are studied. The price is defined by the sum of the terms corresponding to the amortization and financial charges, fuel storage, fuel recharging, and operational costs. Formulas giving the relationship between these parameters are derived and discussed. (J.S.R.)

12765 RADIOCHEMICAL BEHAVIOR OF PARTICULATE CORROSION PRODUCTS IN THE SM-1 DURING CORE 1. C. R. Bergen (Alco Products, Inc., Schenectady, N. Y.). Ind. Eng. Chem., Prod. Research and Develop., 1: 10-15(Mar. 1962).

An analysis of the behavior of particulate corrosion products (crud) during Core 1 life of the SM-1 with reference to the long-lived gamma emitters, Co^{60}, Co^{58}, Fe^{59}, Cr^{51}, and Mn^{54} is presented. The effects of power level, operating history, crud concentration, and oxygen concentration in the coolant are resolved. The resulting data provide a firm basis for predicting and comparing activity build-up of future reactors. (auth)

12766 ECONOMIC AND OTHER ENVIRONMENTAL CONSIDERATIONS IN REACTOR EVALUATION. W. R. Keagy (Atomelectra Ltd., Zurich). Neue Tech., 3: 601-9 (Oct. 1961). (In English)

The various factors which determine unit nuclear power costs and identifies those which vary significantly from one locality to another are reviewed. Important differences between Switzerland and the U.S.A. are found in several items affecting the fixed cost component such as the cost of land, containment requirements, interest rates, taxes, and plant utilization. Various fuel cycles are discussed and compared with respect to the requirements of the Swiss economy. (auth)

12767 SOME PROBLEMS OF GAS-COOLED HIGH TEMPERATURE REACTORS. H. Albers (EIR, Würenlingen, Switzerland), P. Moser, and W. Spillmann. Neue Tech., 3: 627-56(Oct. 1961). (In German)

On the basis of existing literature the possibilities of high-temperature gas-cooled reactors are discussed with respect to the peaceful use of nuclear energy. The special problems offered by this reactor type in the field of reactor physics and technology are examined. (auth)

12768 THE POTENTIAL OF PLUTONIUM AS A FUEL IN NEAR-THERMAL CONVERTER REACTORS. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). Nuclear Sci. and Eng., 12: 135-50(Feb. 1962). (NUMEC-P-26)

The potential of plutonium as a fuel in near-thermal converter reactors is investigated. Over certain ranges of fuel loading and/or moderation, it is shown that the effective absorption cross section (averaged over the entire neutron spectrum) of Pu^{240} decreases with fuel burnup; i.e., decreases with the associated softening of the neutron spectrum. The plutonium, therefore, behaves as a self-stabilizing or self-compensating fuel with the decrease in Pu^{240} cross section balancing fissionable material burnup and fission product build-up. Thereby long core lives are attainable with nominal shim control requirements. The strong neutron temperature dependence of the effective Pu^{240} absorption cross section also results in a highly negative temperature coefficient of reactivity and thereby in the feasibility of spectral shift shim control. Economics evaluation indicates that fuel cycle costs of between 1.5 and 2.5 mills/kw-hr may be attainable with these plutonium fueled systems. (auth)

12769 THE POTENTIAL OF PLUTONIUM AS A FUEL IN NEAR-THERMAL BURNER REACTORS. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). Nuclear Sci. and Eng., 12: 151-6(Feb. 1962). (NUMEC-P-29)

The influence of plutonium as a fuel constituent on burner reactor behavior is examined. Both the SM-1 and the Shippingport seed lattices are investigated. It is found that the decrease in the effective absorption cross section of Pu^{240} with fuel burnup gives the plutonium the characteristic of a self-compensating fuel, thereby leading to the extension of core life with minimum shim control requirements. The illustrated behavior is similar to converter-type reactors. (auth)

12770 A THREE-DIMENSIONAL DEPLETION ANALYSIS OF THE FIRST SHIPPINGPORT PRESSURIZED WATER REACTOR. D. H. Jones and R. P. Christman (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 12: 276-84(Feb. 1962).

The first Shippingport seed-blanket core was operated for 5530 equivalent full power hours at equilibrium xenon and samarium conditions. The comparison of physics measurements and calculations presented are those applicable to the first core containing the initial seed material. A three-dimensional diffusion theory depletion analysis indicates that this calculational model describes with reasonable accuracy the directly observed and inferred reactor parameters examined over core lifetime. The reactor parameters compared include: criticality, reactivity lifetime, xenon transient behavior, temperature coefficients, and blanket power fraction. While the primary emphasis is on the three-dimensional calculational and experimental comparisons, the results of one and two-dimensional diffusion theory depletion calculations are included to indicate their relative merit. The results indicate that such reactor parameters as excess reactivity, temperature coefficients, and blanket power fraction, may be estimated to within approximately the same accuracy by one and two-dimensional depletion models as by this par-

ticular three-dimensional model. This conclusion must be qualified by noting the crudeness employed in the three-dimensional depletion model. (auth)

12771 IMPROVEMENTS IN OR RELATING TO THE STARTING OF INTERNAL COMBUSTION ENGINES. Alfred Mitchell Benjamin (to United Kingdom Atomic Energy Authority). British Patent 891,340. Mar. 14, 1962.

A simplified starting-up arrangement is designed for automatic start-up of a standby internal combustion engine in event of reactor shutdown in nuclear power stations. The engine is actuated by compressed air, and then the arrangement acts to close the compressed-air valve. (D.L.C.)

Production Reactors

12772 ON THE POSSIBILITIES OF THE OPERATION OF A BREEDER WITH NATURAL URANIUM WITHOUT REPROCESSING OF FUEL. Klaus Fuchs and Hans Hessel. Jaderná energie, 8: 37-42(1962). (In Czech.)

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 5069.

12773 HEAVY WATER MODERATED REACTORS AS CONVERTER AND BREEDER. R. Ferrarini (ETH, Gebr. Sulzer A. G., Winterthur, Switzerland) and R. W. Meier. Neue Tech., 3: 680-700(Oct. 1961). (In German)

Demonstration of technical feasibility of various designs is the main aim of present heavy water moderated power reactor development. These are based on one of a number of different coolant mediums, such as pressurized or boiling D_2O, gas, steam, fog, organics, and liquid metals. Several plants are either in operation or in an advanced state of construction. The excellent neutron economy of heavy water as a moderator favors the D_2O concept for high conversion of fertile to fissile material. There is even some good hope that positive breeding gains can be achieved in the thorium-U^{233} cycle. In case of the uranium–plutonium cycle high conversion ratios are expected. The physical, technological, and safety aspects of these two fundamental cycles are discussed. (auth)

Research Reactors

12774 (FD-78) PRODUCTION RECORDS AND IRRADIATION PERFORMANCE OF NRU FLAT TYPE FUEL RODS. W. R. Green (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 13p.

For presentation at the Fourteenth Joint U.S.- Canadian Sheath Program Meeting, Savannah River Plant, No. 7 and 8, 1961.

The average yield of NRU type 2B flats from the initial dingot has been ~65%. None of the 1383 assemblies (6915 flats) were removed because of cladding failures. None of the irradiated flats examined had cracks or blisters, but all showed "orange peel." An experimental program of test beta-quenched, alpha-annealed flats showed that this treatment seemed to result in less surface roughness upon irradiation. (auth)

12775 (GEAP-3135) THE RHODE ISLAND AND PROVIDENCE PLANTATIONS ATOMIC ENERGY COMMISSION NUCLEAR SCIENCE CENTER. VOLUME II. SAFEGUARD REPORT. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 20, 1959. 135p.

A description and safeguard evaluation is presented of an open pool research and test reactor rated at 1 Mw. The reactor is light water moderated and cooled, graphite reflected, and heterogeneously fueled with 3.8 kg of 90% enriched U^{235}. The core is supported by a suspension frame in an open pool. The major experimental facilities converge toward the core and afford ample opportunity for the simultaneous performance of a number of different experiments. The principle reactor design characteristics and the experimental facilities are summarized. (B.O.G.)

12776 (IDO-16661) STANDARD MTR FUEL LOADING PROCEDURE. R. W. Goin (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Jan. 30, 1961. Contract AT(10-1)-205. 18p.

A detailed description is given concerning the procedure used to calculate MTR fuel loadings. No theoretical background or justification for the procedures used are given, however references are included. (J.R.D.)

12777 (ORNL-3206) AN EVALUATION OF THE URANIUM CONTAMINATION ON THE SURFACES OF ALCLAD URANIUM–ALUMINUM ALLOY RESEARCH REACTOR FUEL PLATES. R. J. Beaver, J. H. Erwin, and R. S. Mateer (Oak Ridge National Lab., Tenn.). Mar. 19, 1962. Contract W-7405-eng-26. 31p.

Reported radioactivity in the Low-Intensity Test Reactor (LITR) water coolant traceable to uranium contamination on the surfaces of the alclad uranium–aluminum plate-type fuel element led to an investigation to determine the sources of uranium contamination on the fuel plate surfaces. Two possible contributors to surface contamination are external sources such as rolling-mill equipment, the most obvious, and diffusion of uranium from the uranium–aluminum alloy fuel into the aluminum cladding. This diffusion is likely because of the 600°C heat treatments used in the conventional fabrication process. Uranium determinations based on neutron activation analysis of machined layers from fuel plate surfaces showed that rolling-mill equipment, contaminated with highly enriched uranium, was responsible for transferring as much as 180 ppm U^{235} to plate surfaces. By careful practice where cleanliness is emphasized, surface contamination can be reduced to 0.6 ppm U^{235}. The residue remaining on the plate surface may be accounted for by diffusion of uranium from the fuel alloy into and through the cladding of the fuel plate. Data obtained from preliminary diffusion studies permitted a good estimate to be made of the diffusion coefficient of uranium into aluminum at 600°C: 2.5×10^{-9} cm^2/sec. To minimize diffusion while the plate-type aluminum-base research reactor fuel element is being processed, heat treatments at 600°C should be limited to 2.5 hr. The uranium contamination on the surfaces of the finished fuel plates should then be less than 0.6 ppm U^{235}. This investigation also revealed that the solubility limit of uranium in aluminum at 600°C is approx 60 ppm. (auth)

12778 (FTD-TT-62-30) CONCERNING THE DISCOVERY OF THE PRINCIPLE OF THE PULSE REACTOR. K. Fuchs. Translated from Kernenergie, 4: 685-7(1961). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 7309.

12779 INITIAL START-UP OF THE HIGH FLUX REACTOR. Atoomenergie, 3: 247-50(Dec. 1961). (In Dutch)

On november 9, 1961, the Petten High Flux Reactor went critical for the first time. A report is given on the critical experiments. (tr-auth)

12780 DESIGN AND OPERATION OF A MONITORING STATION IN THE SURROUNDING OF THE BERLIN RESEARCH REACTOR (BER). W. Jacobi and H.-G. Barz

(Hahn-Meitner-Institut für Kernforschung, Berlin). Kerntechnik, 4: 8-13(Jan. 1962). (In German)

Design and operation experiences are reported from a monitoring station in the surroundings of the Berlin Research Reactor (BER) which continuously measures and registers the $\beta + \gamma$ radiation from ground and air, the specific activity of air and rain, as well as meteorological data. The sensitivity of the monitoring equipment was demonstrated by registrations, showing the variation of $\beta + \gamma$ radiation. The observed average values of fission-product activity and Pb^{214}, Bi^{214}-activity in air and rain are given. (auth)

12781 CALORIMETRIC GAMMA FLUX MEASUREMENTS AT THE RESEARCH REACTOR MUNICH. W. Schilling and H. Meissner (Technische Hochschule, Munich). Kerntechnik, 4: 14-16(Jan. 1962). (In German)

The gamma heat of an aluminum rod cooled at one end was determined at various positions in the radiation field of the Munich Research Reactor. The gamma energy absorbed per gram could be investigated by measuring the temperature distribution along the rod by means of the thermal conductivity of the material. The value of the gamma flux in roentgen/hr was calculated. At a reactor power of 1 Mw, gamma flux in the central position in the core was 2.4×10^8 r/hr, and in the reflector 1.0×10^8 r/hr. The results corresponded well with the values measured for a similar reactor type and calculated for a simplified model. (auth)

12782 THE CONTROL SYSTEM OF THE ISPRA-1 REACTOR. S. Barabaschi and A. Pulacci (Comitato Nazionale per l'Energia Nucleare, Varese, Italy). Nuclear Sci. and Eng., 12: 160-8(Feb. 1962).

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 4981.

SPACE APPLICATIONS AND TECHNOLOGY

12783 (CNLM-2370-3(Pt.I)) SPACE PROPULSION AND AUXILIARY POWER UNITS. A Bibliography. Elizabeth A. Cernak, comp. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Aug. 2, 1960. Contract [AT(11-1)-229]. 42p.

A partially annotated bibliography of 246 unclassified references is presented on advanced space propulsion units, auxiliary power units, and energy and mission requirements. Corporate author and subject indexes are included. (D.L.C.)

12784 (NAA-SR-6308) SNAP II POWER CONVERSION SYSTEM TOPICAL REPORT NO. 16, 2500-HOUR ENDURANCE TEST OF MERCURY RANKINE CYCLE POWER SYSTEM. Paul E. Grevstad (Tapco. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Jan. 1961. For Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Contract [AT-11-1-GEN-8], Subcontract N 843 FS-101221. 64p.

SNAP 1 is the designation for the 0.5-kw nuclear auxiliary power supply intended for application in a satellite. SNAP 1 was designed to convert thermal energy from the decay of a radioisotope into electrical energy using a Rankine engine with mercury as the working fluid. A successful 2500-hour endurance test is described of a complete developmental version of the SNAP 1 power conversion system utilizing a prototype turbomachinery package, an electrically heated boiler, and an air-cooled condenser. Indications from the data obtained during the test and from inspection of the system following the test were that many more hours of satisfactory operation could have been obtained on all major system components except the rotating unit pump. The mercury-lubricated bearings, the turbine, and the alternator, all demonstrated excellent endurance capability. Based on previous component tests, it is concluded that the pump performance deterioration was caused by air entrainment in the liquid Hg. (auth)

12785 (NAA-SR-6439) SNAP 2 PRIMARY COOLANT DEVELOPMENT. M. A. Perlow (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1961. Contract AT-11-1-GEN-8. 70p.

The design, development, testing, and selection of components integral to the primary coolant system for the SNAP 2 (Systems for Nuclear Auxiliary Power) reactor for space applications are described. Included are core hydraulic studies, heater (resistance element and transformer types) development, corrosion studies (NaK-78 is the primary coolant), NaK hydride precipitation studies, and lithium hydride (tentatively selected as the SNAP 2 radiation shielding medium) studies. (auth)

12786 (NAA-SR-6476) BEARING MATERIALS COMPATIBILITY FOR SPACE NUCLEAR AUXILIARY POWER SYSTEMS. W. J. Kurzeka (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 1, 1961. Contract AT-11-1-GEN-8. 60p.

A program to evaluate materials for suitability as exposed bearings on nuclear auxiliary power systems (SNAP Program) for space vehicles is reported. Friction coefficients of material combinations in a 10^{-6} mm Hg vacuum at 1000°F for 200 hr were measured. Seven combinations found to have friction coefficients less than 0.50 are: graphite-Haynes 90; graphite-Stellite No. 3; graphite-Al_2O_3 (sprayed); Al_2O_3 (sprayed)-Cr_3C_2 (sprayed); Al_2O_3 (sprayed)-TiC; Al_2O_3 (solid)-3-F-12; and Al_2O_3 (solid)-3-N-12. (auth)

12787 (NASA-TN-D-1168) ACCELERATOR GRID TESTS ON AN ELECTRON-BOMBARDMENT ION ROCKET. William R. Kerslake (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Feb. 1962. 42p.

A systematic investigation of screen-accelerator grids was made with an ion rocket having a 10-cm-dia. electron-bombardment ion source. Mercury ion beams of 0.03 to 0.44 ampere were operated at net accelerating voltages of 900 to 6100. The experimental work was conducted in a bell jar connected to a vacuum tank of 5-ft-dia. and 16-ft length. Various multihole grid plate spacings, hole sizes, plate thicknesses, and grid materials were studied. Data are presented for 15 different sets of screen-accelerator multihole plate grids and, for comparison, wire grids. (auth)

12788 (NP-11292) THE RESISTOJET. James M. Howard (Marquardt Corp., Van Nuys, Calif.). 1961. 14p.

Paper No. 2126-61 for presentation at American Rocket Society Space Flight Report to the Nation, New York Coliseum, October 9-15, 1961.

Analytical and experimental development work leading to a prototype resistance-heated hydrogen rocket is described. Preliminary test results indicate that very high electrical conversion efficiencies are attainable. Test methods, heat transfer, and efficiency are discussed. (auth)

12789 (NP-11384) RESEARCH SUMMARY NO. 36-12, VOLUME 1 FOR THE PERIOD OCTOBER 1, 1961 TO DECEMBER 1, 1961. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Jan. 2, 1962. Contract NAS 7-100. 141p.

Research and development progress at the Jet Propulsion Laboratory is reported. Topics discussed include space sciences research, space instruments development, experimental space science, systems analysis, guidance and control research, flight computers and sequencers, communications elements research, communications systems research, gas dynamics research, chemistry and physics research, engineering materials research, wind tunnels, instrumentation, computer applications and data systems, and liquid propellant propulsion. (M.C.G.)

12790 (TID-15207) EXPERIMENTAL RESULTS FROM SOVIET SATELLITE FLIGHTS—A PRELIMINARY BIBLIOGRAPHY. J. Arthur Freed, Comp. (Los Alamos Scientific Lab., N. Mex.). Sept. 1, 1961. Contract [W-7405-eng-36]. 12p. (D-BIB-36)

A list is presented of 68 references containing information on experimental results from Soviet satellite flights. (C.H.)

WASTE DISPOSAL AND PROCESSING

Refer also to abstracts 11782, 11961, and 12704

12791 (HW-57288) PLUTONIUM RECOVERY FROM CONTAMINATED MATERIALS. PROJECT CGC-813—PROCESS DESIGN. E. Doud (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 27, 1958. Contract [W-31-109-eng-52]. 25p.

The process design is presented for a facility to recover plutonium from contaminated materials. Incineration of combustible material and leaching of non-combustible material are practical methods of recovering plutonium from the 234-5 facility contaminated wastes. At an estimated recovery efficiency of 90%, it is anticipated that approximately 6 kg of plutonium will be recovered each year. The contaminated materials will be processed in a completely enclosed system employing glove-box operating practices. The incinerator off-gases and hood exhausts will be scrubbed and filtered before release to the stack. (auth)

12792 (HW-58610) PLUTONIUM RECOVERY FROM CONTAMINATED MATERIALS, PROJECT CGC-813—SCOPE REVISION No. 1. E. Doud (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 23, 1959. Contract [AT(45-1)-1350]. 15p.

An inventory of the contaminated materials accumulated since June 1958 revealed a large variety and quantity of materials that could be burned. Proposed equipment changes are presented for increased capacity and flexibility in handling and recovery of Pu from contaminated materials. These include the provision of equipment for sorting and accessories for preparing the material for feed to a sizing machine, replacement of the batch operated box incinerator with an electrically heated continuous belt muffle type incinerator, provision of a third off-gas scrubber upstream to the caustic scrubber, provisions for triple filtration on both hood and flue gas exhausts with parallel units on the two final stages, and building ventilation exhaust filters and duct to a stack. The facility, as initially scoped, was sized to handle 17.5 pounds or 2.5 cubic feet of contaminated materials each day. The batch type equipment was scheduled to operate eight hours per day five days per week. The future waste accumulation rate has been estimated to be 100 pounds or 15 cubic feet per day. Consequently, it is proposed to increase the capacity to permit processing, during an eight-hour shift, 100 pounds or 15 cubic feet of waste with a burning rate equivalent to that of corrugated cardboard. Also continuous type equipment is proposed to allow 24-hour operation for working off the backlog. The arrangement of the equipment is shown on a drawing. (auth)

12793 (HW-72324) RESEARCH AND DEVELOPMENT ACTIVITIES FIXATION OF RADIOACTIVE RESIDUES, QUARTERLY PROGRESS REPORT, OCTOBER—DECEMBER 1961. E. R. Irish, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 15, 1962. Contract AT(45-1)-1350. 37p.

Research and development activities in fixation of radioactive wastes are reported. Spray calcination, batch calcination, in-tank solidification, off-gas treatment, sorption and extraction studies, low- and intermediate-level wastes, and high-level wastes are discussed. (M.C.G.)

12794 (IDO-14570) STAINLESS STEEL WASTES. III. LABORATORY STUDIES OF THE RATE OF REMOVAL OF STAINLESS STEEL IONS BY MERCURY CATHODE ELECTROLYSIS. D. R. Anderson and D. W. Rhodes (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 12, 1962. Contract AT(10-1)-205. 20p.

The removal rates of iron, nickel, and chromium from synthetic stainless steel waste solutions during electrolysis over a mercury cathode were studied. The loading capacity of the mercury for the stainless steel metals was estimated on the basis of laboratory experiments to be about two % by weight. The laboratory data indicated that, at an electrode potential of –1.80 volts vs S.C.E., 85 ampere-hours per liter of waste removed essentially all of the stainless steel ions from a sulfuric acid solution containing 0.13M metal ions at 35°C. (auth)

12795 (ORNL-TM-133) WASTE TREATMENT AND DISPOSAL PROGRESS REPORT FOR OCTOBER AND NOVEMBER 1961. R. E. Blanco and E. G. Struxness (Oak Ridge National Lab., Tenn.). Mar. 13, 1962. Contract [W-7405-Eng-26]. 72p.

High-Level Waste Calcination. Chemical flowsheets for TBP-25 process waste were completed for the ICPP Pot Calciner Pilot Plant, and Darex and Purex flowsheets are under preparation. Volatilization of Cs during evaporation and meltdown of a phosphate-lead glass (maximum temperature 1000°C) containing simulated TBP-25 waste oxides was ≤0.3%. In a similar test Ru was 59.8-0.67% volatilized in the presence of 0-2 moles of H_3PO_3 when the experiment was performed in a quartz pot vs 47.2-0.11% in a stainless steel pot. In vapor-liquid equilibrium studies with 0.5-10 M HNO_3 at 748 mm Hg, the relation between the logarithms of the distillation factors of Ru and HNO_3 was linear. In the presence of 1.7 M $Al(NO_3)_3$, the relation was approximately linear up to 1 M HNO_3, but Ru volatility increased at higher acidities. At distillation pressures of 565 and 444 mm Hg, Ru volatility from 1.7 M $Al(NO_3)_3$-4 M HNO_3 was decreased by factors of ~11 and 17, respectively. Addition of 0.1 M H_3PO_3 decreased the Ru volatility from 12 M HNO_3 and from 1.7 M $Al(NO_3)_3$-2 M HNO_3 by factors of 420 and 208, respectively. A glass made by evaporating and melting simulated TBP-25 waste solution 2 M in NaH_2PO_2 and 0.25 M in PbO was leached at rates which decreased from 2.1×10^{-6} to 2.5×10^{-7} g/cm²/day at the end of the first and fifth weeks, respectively. In a semicontinuous evaporation and calcination to 1000°C, a glass was formed with a density of 2.9 g/ml, 1 vol of glass representing 8 vol of waste. About 90% of the Hg and 24% of the Ru were volatilized, the latter believed due to equipment malfunction. Low-Level Waste Treatment. Three low-level pilot plant demonstration runs were made, for a total of 234 hr operation, on 134,000 gal of ORNL tap water. In a run with ORNL process waste water, a total of 44,425 gal (representing 1564 bed volumes) of waste was treated in 72 hr of continuous processing. The major contaminants, Sr and Cs, were removed from the feed by factors of 2956 and 287, respectively. Analysis of plant effluent samples indicated a product that was 0.9 and 0.009% of current MPC_W values for Sr^{90} and Cs^{137} for a 168-hr week. A new titration procedure for determination of total hardness was developed with a sensitivity of 1 ppm vs 20 ppm for the procedure formerly used. Engineering, Economic, and Hazards Evaluation. The amounts of floor area to be mined for the storage of calcined solid wastes in rooms in salt deposits were calculated for storage of Purex and Thorex

wastes from a 15,000 MW_e (70,000 MW_t) nuclear economy. Criteria for storage were that the calcined solids in cylindrical vessels must not exceed 1650°F (the maximum calcination temperature) and that the salt surface must not exceed 400°F. For storage in 6-in.-dia vessels, the minimum decay time from reactor discharge to storage in salt for acidic Purex waste is about 1.1 years, but reacidified Purex, acidic Thorex, reacidified Thorex, and acidic Thorex glass could be stored immediately after processing (120 days after reactor discharge). For storage in 24-in.-dia vessels, minimum decay times varied from 0.63 year for reacidified Thorex to 8.3 years for acidic Purex waste. Mined space requirements varied from 14.8 acres/year with 0.33 year's decay time to 2.25 acres/year with 30 years' decay time, a factor of 2.3 less than for storage of liquid wastes. Disposal in Deep Wells. The first fracturing experiment showed that the method used was capable of developing an essentially conformable fracture in the shale under the conditions of the experiment, and that the fracture tended to follow the bedding plane into which it was injected despite a moderately complex structure of open folds, small drag folds, and minor faults. It also showed that the test method was capable of giving a clear picture of the location and extent of the fracture, limited only, for practical purposes, by the number of test wells drilled to locate the grout. Disposal in Natural Salt Formations. It was found that rock salt samples shatter rather violently when heated in a muffle furnace at 250 to 300°C. A test in the Hutchinson mine, with a 5-ft-long 6-in.-dia cylindrical heat source buried in a drilled hole 8 in. dia and 10 ft deep, is planned to investigate this effect. Clinch River Study. Analytical results on core samples of bottom sediments taken at 10 equally spaced intervals along five cross-sections, CRM 4.7, 7.6, 11.9, 15.3, and 19.2, indicate that the vermiculite, kaolinite, and interstratified vermiculite-mica contents are about the same in the clay-size fraction of bottom sediments in the study reach. Quartz is the most abundant mineral in these sediments. The micaceous clay content is greater downstream from CRM 15.3 than at this or the next upstream section. The exchangeable Mg content and the determined exchange capacity of the bottom sediments are nearly constant through the study reach, but the exchangeable Ca content is greatest near the mid sections. Fundamental Studies of Minerals. Four sulfide minerals —pyrite (FeS_2), chalcopyrite ($CuFeS_2$), chalcocite (Cu_2S), and stibnite (Sb_2S_3)— were investigated for sorption of Ru. Sorption was quite high for all minerals from synthetic waste solution tagged with $Ru^{106}Cl_3$ but low from the untreated seep solution of operating waste pits. Sorption was increased when $Na_2S_2O_4$ was used to reduce the Ru in an alkaline medium. Ru removal from solution was optimum in the pH range 6 to 11, where polymeric ruthenium dioxide is at a maximum. White Oak Creek Study. A study of the Sr in the creek at these stations indicates: (1) in general, the total amount of Sr in the creek varies with stream discharge; (2) the amount of sorbed Sr varies between 0.5 and 17% of the total present; (3) there is a relation between the percentage of sorbed Sr and the concentration of suspended solids in the creek water; and (4) less than 5% of the Sr detected at the station in the plant area is due to fallout. (auth)

12796 (AEC-tr-5013) STUDY OF DILUTION IN THE RHONE OF RADIOACTIVE EFFLUENTS FROM THE MARCOULE CENTER. J. Rodier, J. Scheidhauer, M. Marichal, and R. Court (France. Commissariat à l'Énergie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). 1961. Translated from report CEA-2003. 35p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 9723.

12797 (NP-tr-863) STUDIES ON THE DEACTIVATION OF RADIOACTIVE EFFLUENTS BY ELECTRODIALYSIS. S. Krawczynski. Translated by R. Todd (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Atomkernenergie, 6: 250-60(June 1961). 36p. (Includes original, 10p.).

Also issued as German Report KFK-63.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 27252.

12798 CESIUM EXCHANGE PROPERTIES OF VERMICULITE. D. G. Jacobs (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 12: 285-92(Feb. 1962).

The use of a mineral-filled column is regarded as an inexpensive, yet efficient, alternative method for waste decontamination. For this purpose the cesium-exchange properties of various grades of commercially available vermiculite were investigated and compared to other natural ion-exchange materials. Elucidation of the reaction mechanism has led to improvement of the cesium-sorptive properties, either by potassium treatment or heat treatment of the vermiculite or by addition of potassium to the waste stream. Studies of the kinetics and the thermodynamics of the exchange reaction permit extrapolation of the data for consideration of the extended use of vermiculite columns for decontaminating other waste streams. Data obtained from bench-scale and field-scale (10-ft long, 2-in. ID) column studies compare closely with those obtained by slurry studies. The breakthrough curves obtained were sufficiently steep to indicate that the partial cesium-sorptive capacity of a vermiculite column would be completely utilized if two columns were operated in series. A column 10 ft long and 10 ft in diameter filled with Na-treated vermiculite is estimated to be capable of decontaminating more than 5×10^5 gal of ORNL intermediate-level waste. Larger volumes of waste streams having lower concentrations of stable salts could be decontamined with respect to cesium and strontium. (auth)

12799 EXTRACTION OF URANIUM FROM WASTE WATERS OF CHEMICAL PLANTS AND RESEARCH LABORATORIES. L. D. Skrylev and S. G. Mokrushin. Zhur. Priklad. Khim., 34: 2403-7(Nov. 1961). (In Russian)

The extraction of small amounts of uranium from waste waters of chemical plants and research laboratories by direct precipitation with potassium ferrocyanide, followed by the separation of mixed uranyl ferrocyanide by frothing, is discussed. (R.V.J.)

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

æ	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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1440	16-11473	Can. J. Biochem. and Physiol. 40: 413-17 (1962)
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3627	16-12455	Brit. J. Appl. Phys. 13: 131-3(1962)
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4891	16-11741	p.3-15 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy, 1961.
5456	16-12678	Nuclear Sci. and Eng. 12: 218-24(1962)
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80	16-12735	Dep.(mc); $6.60(fs), $2.03(mf) OTS
130	16-12653	Dep.(mc); $6.60(fs), $2.09(mf) OTS
134	16-11779	Dep.(mc); $2.60(fs), $1.07(mf) OTS
165	16-11780	Dep.(mc); $4.60(fs), $1.67(mf) OTS
177	16-11829	Dep.(mc); $1.60(fs), $0.80(mf) OTS
216	16-12025	Dep.(mc); $3.60(fs), $1.31(mf) OTS
EXP-NRX–	**(Canadian)**	
5903	16-12736	Dep.; $1.50(AECL)
FD–	**(Canadian)**	
72	16-12069	Dep.(mc)
76	16-12070	Dep.(mc)
78	16-12774	Dep.(mc)
FTD-TT–	**(Non-AEC)**	
61-68	16-11833	OTS
61-240	16-12120	OTS
61-281	16-12239	OTS
61-459	16-12073	OTS
62-14	16-11585	OTS
62-30	16-12778	OTS
GA–	**(Misc.)**	

Report No.	Abstract No.	Availability
1526	16-12091	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1584(Rev.)	16-12407	Nuclear Sci. and Eng. 12: 190-202(1962)
2669	16-11976	Dep.; $0.50(OTS)
2848	16-12092	Dep.(mc); $2.60(fs), $0.86(mf) OTS
GAMD–	**(Misc.)**	
1208	16-12737	Dep.(mc); $7.60(fs), $2.67(mf) OTS
GEAP–	**(Misc.)**	
3135*	16-12775	Dep.(mc); $10.50(fs), $4.25(mf) OTS
3787	16-11814	Dep.; $1.25(OTS)
GEL–		
0702	16-11851	Dep.(mc); $4.60(fs), $1.52(mf) OTS
GEMP–		
106C	16-12654	Dep.; $0.75(OTS)
HEPL–	**(Misc.)**	
249	16-12579	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW–		
53319	16-12738	$1.60(fs), $0.80(mf) OTS
57288	16-12791	$2.60(fs), $0.95(mf) OTS
58610	16-12792	Dep.(mc); $1.60(fs), $0.80(mf) OTS
65465	16-12177	Dep.; $0.75(OTS)
67679	16-12071	Dep.; $0.75(OTS)
69168	16-11950	Dep.; $2.25(OTS)
69305	16-12093	Dep.; $0.50(OTS)
69415	16-11781	Dep.; $0.50(OTS)
70638	16-11927	Dep.; $1.00(OTS)
70792	16-11782	Dep.(mc); $2.60(fs), $1.01(mf) OTS
70977	16-12094	Dep.(mc); $1.10(fs), $0.80(mf) OTS
71771	16-12050	Dep.; $0.50(OTS)
72107	16-11951	Dep.; $0.50(OTS)
72266	16-12095	Dep.(mc); $1.60(fs), $0.80(mf) OTS
72324	16-12793	Dep.; $1.00(OTS)
HW-SA–		
2232	16-11932	Nuclear Sci. and Eng. 12: 271-5(1962)
IA–	**(Non-AEC)**	
645	16-12425	Dep.(mc)
704	16-12026	Dep.(mc)
IDO–		
14570	16-12794	Dep.; $0.50(OTS)
14572	16-11783	Dep.; $0.50(OTS)
14578	16-11784	Dep.; $0.50(OTS)
16636	16-12739	Dep.; $1.25(OTS)
16661	16-12776	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16715	16-11852	Dep.; $0.50(OTS)
IFA-RS–	**(Rumanian)**	
15	16-11853	Dep.(mc)
INSJ–	**(Japanese)**	
44	16-12426	Dep.(mc)
IS–		
196	16-12122	Acta Cryst. 15: 252-5(1962)
276	16-11645	J. Nuclear Materials 5: 140-6(1962)
348	16-11352	Dep.; $0.75(OTS)
371	16-11382	Dep.; $2.25(OTS)
ISS–	**(Italian)**	
61/14	16-12330	Dep.(mc)
61/21	16-12331	Dep.(mc)
JAERI–	**(Japanese)**	
5003	16-11952	
JINR–	**(Russian)**	
D-824	16-12332	Dep.(mc)
D-832	16-12427	Dep.(mc)
D-856	16-12428	Dep.(mc)
P-226	16-12333	Dep.(mc)
P-839	16-12334	
P-840	16-12335	Dep.(mc)
P-841	16-12429	Dep.(mc)
P-846	16-12430	Dep.(mc)
P-848	16-11815	Dep.(mc)
P-849	16-12580	Dep.(mc)
P-850	16-12431	Dep.(mc)
P-852	16-12581	Dep.(mc)
P-855	16-12582	Dep.(mc)
P-899	16-12432	Dep.(mc)
JPL-TR–	**(Non-AEC)**	
32-102	16-12215	
JPRS–	**(Non-AEC)**	
11873	16-11367	OTS
12342	16-11586	OTS
12393	16-11468	OTS
12480	16-11488	OTS
12701	16-12001	OTS
12829	16-11469	OTS
KAPL–		
2159	16-12178	Dep.(mc); $7.60(fs), $2.45(mf) OTS
2169	16-12179	Dep.(mc); $4.60(fs), $1.49(mf) OTS
2182	16-12096	Dep.; $1.25(OTS)
KFK–	**(German)**	
80	16-12336	Dep.(mc)
KFK-tr–	**(German)**	
60	16-12004	Dep.(mc); $1.60(fs), $0.80(mf) JCL
KLI–		
3887	16-12229	See TID-15059
LA–		
2662	16-11353	Dep.; $1.00(OTS)
LAR–		
1	16-12097	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2	16-12098	Dep.(mc); $2.60(fs), $0.95(mf) OTS
3	16-12099	Dep.(mc); $3.60(fs), $1.16(mf) OTS
4	16-12100	Dep.(mc); $2.60(fs), $0.92(mf) OTS
7	16-12101	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8	16-12102	Dep.(mc); $2.60(fs), $0.86(mf) OTS
9	16-12103	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10	16-12104	Dep.(mc); $8.10(fs), $2.84(mf) OTS
MIT-NSL–	**(Non-AEC)**	
TR-364	16-12216	
ML–	**(Misc.)**	
872	16-12227	See TID-14666
MLM–		
1119	16-11502	Dep.; $1.60(fs), $0.80(mf) OTS
1127	16-11998	Dep.; $1.75(OTS)
MND-C–		
2501	16-12012	Dep.; $4.50(OTS)
MND-M–	**(Misc.)**	
1859	16-12655	Dep.; $2.75(OTS)
MND-P–		
2613	16-11996	Dep.; $1.25(OTS)
2614	16-11997	Dep.; $1.25(OTS)
N–	**(Misc.)**	
6019	16-12752	See TID-14557
NAA-AER-Memo–		
1173	16-12217	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NAA-SR–		
193	16-12180	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5244	16-11816	Dep.(mc); $4.60(fs), $1.70(mf) OTS
5503	16-12743	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5308	16-12784	Dep.(mc); $6.60(fs), $2.12(mf) OTS
6439	16-12785	Dep.(mc); $6.60(fs), $2.24(mf) OTS
6476	16-12786	Dep.(mc); $5.60(fs), $1.91(mf) OTS
6493	16-12051	Dep.; $0.75(OTS)
6608	16-12324	Dep.; $0.50(OTS)
6880	16-12105	Dep.; $0.50(OTS)
6890	16-12740	Dep.; $0.75(OTS)
NAA-SR-Memo–		
3486	16-12741	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5182	16-12742	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6581	16-12744	Dep.(mc); $4.60(fs), $1.49(mf) OTS
6662	16-12745	Dep.(mc); $2.60(fs), $0.98(mf) OTS
NAA-SR-TDR–		
6540	16-12746	Dep.(mc); $2.60(fs), $0.89(mf) OTS
NASA-TN–	**(Misc.)**	
D-1168*	16-12787	$1.25(OTS)
D-1191*	16-12218	$1.00(OTS)
NBS–	**(Misc.)**	

Report No.	Abstract No.	Availability
7218	16-12612	Dep.(mc); $2.60(fs), $1.01(mf) OTS
NDL-TR-	(Non-AEC)	
21	16-12013	
NEVIS-		
102	16-12433	Dep.(mc); $2.60(fs), $1.07(mf) OTS
NIRL-R-	(British)	
2	16-12583	Dep.(mc); $0.98(BIS)
3	16-11817	Dep.(mc); $0.42(BIS)
5	16-12584	Dep.(mc); $0.63(BIS)
6	16-12585	Dep.(mc); $0.70(BIS)
15	16-12434	Dep.(mc)
NLCO-		
685	16-11774	Dep.(mc); $12.00(fs), $5.15(mf) OTS
790	16-11775	Dep.(mc); $8.10(fs), $2.69(mf) OTS
NMI-	(Misc.)	
7244	16-12747	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7245	16-12748	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NP-	(AEC File No. for Non-AEC Reports)	
11175	16-12337	
11292	16-12788	
11304	16-12219	
11313	16-11830	Dep.(mc); $2.80(BIS)
11332	16-12404	
11342	16-12220	Dep.(mc)
11346	16-12221	
11366	16-11854	
11373	16-12027	
11374	16-12106	
11376	16-12435	Dep.(mc)
11377	16-11855	
11380	16-11998	Dep.(mc)
11383	16-12613	
11384	16-12789	
11386	16-11856	
11409	16-11383	
11410	16-12028	
11414	16-12614	OTS
11417	16-11354	Dep.(mc)
11419	16-12436	
11424	16-11384	
11427	16-12222	
11428	16-12223	
11433	16-12615	
11434	16-12107	
11436	16-12224	
11448	16-11686	OTS
11449	16-11385	
11560	16-11386	
11579	16-11513	Dep.(mc)
11580	16-11934	Dep.(mc)
NP-tr-	(AEC File No. for Non-AEC Translations)	
833	16-11871	Dep.(mc); $1.60(fs), $0.80(mf) JCL
837	16-11504	Dep.(mc); $4.60(fs), $1.64(mf) JCL
840	16-12240	Dep.(mc); $4.60(fs), $1.55(mf) JCL
852	16-11819	OTS
858	16-11708	Dep.(mc); $2.60(fs), $0.89(mf) JCL
861	16-12186	Dep.(mc); $2.60(fs), $0.92(mf) JCL
863	16-12797	Dep.(mc); $3.60(fs), $1.28(mf) JCL
864	16-12035	Dep.(mc); $1.60(fs), $0.80(mf) JCL
866	16-12002	Dep.(mc); $2.60(fs), $0.86(mf) JCL
NRC-	(Canadian)	
6669	16-11593	Can. J. Chem. 40: 557-9(1962)
NRL-	(Misc.)	
5744*	16-11857	$0.50(OTS)
NUMEC-P-		
26	16-12768	Nuclear Sci. and Eng. 12: 135-50(1962)
29	16-12769	Nuclear Sci. and Eng. 12: 151-6(1962)
90	16-12656	Dep.(mc); $7.60(fs), $2.60(mf) OTS
NYO-		
7986	16-11687	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8121	16-12108	Dep.(mc); $2.60(fs), $0.92(mf) OTS

Report No.	Abstract No.	Availability
9175	16-11785	Dep.; $2.50(OTS)
9284	16-12437	Dep.(mc); $11.50(fs), $4.97(mf) OTS
9285	16-12438	Dep.(mc); $9.60(fs), $3.74(mf) OTS
9530	16-11976	Dep.; $2.25(OTS)
9808	16-12225	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9853	16-11999	Dep.(mc); $8.10(fs), $2.63(mf) OTS
9949(Pt.III)	16-12730	See CEND-150(Pt.III)
9949(Pt.V)	16-12731	See CEND-150(Pt.V)
10006	16-12072	Dep.; $1.50(OTS)
10126	16-12310	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORA-	(Misc.)	
2900-265-T*	16-12204	See AD-261673
3049-3-P	16-12182	See TID-15122
ORNL-		
3191	16-11858	Dep.; $2.25(OTS)
3206	16-12777	Dep.; $0.75(OTS)
3219	16-11786	Dep.; $0.75(OTS)
3233	16-12029	Dep.; $0.50(OTS)
3244	16-11787	Dep.; $0.50(OTS)
3255	16-12014	Dep.; $0.50(OTS)
ORNL-TM-		
13	16-12226	Dep.(mc); $1.60(fs), $0.80(mf) OTS
34	16-11503	Dep.(mc); $6.60(fs), $2.24(mf) OTS
107	16-11788	Dep.(mc); $4.60(fs), $1.64(mf) OTS
130	16-11789	Dep.(mc); $2.60(fs), $0.83(mf) OTS
133	16-12795	Dep.(mc); $7.60(fs), $2.36(mf) OTS
ORO-		
483	16-11514	Dep.; $0.50(OTS)
517	16-11387	Dep.; $2.25(OTS)
518	16-12109	Dep.(mc); $2.60(fs), $0.95(mf) OTS
PATENTS	(British)	3s. 6d. each, U. K. Patent Office
890,523	16-12713	
890,572	16-12714	
890,659	16-11921	
890,661	16-12715	
890,737	16-12172	
890,741	16-11922	
890,854	16-11923	
890,971	16-12173	
891,039	16-11822	
891,179	16-12716	
891,204	16-11823	
891,299	16-12717	
891,340	16-12771	
891,353	16-12718	
891,354	16-12719	
891,424	16-11924	
891,436	16-11808	
891,457	16-11777	
891,508	16-11824	
891,521	16-11778	
891,525	16-12720	
891,708	16-12721	
PATENTS	(French)	
1,133,803	16-12002	See NP-tr-866
PATENTS	(German)	
1,074,880	16-11555	
PATENTS	(U. S.)	$0.25 each, U. S. Patent Office
3,026,196	16-12048	
3,026,256	16-12722	
3,026,258	16-12723	
3,026,414	16-11825	
PATENTS	(U.S.S.R.)	
128,030	16-12073	See FTD-TT-61-459
PG-Report-	(British)	
59	16-11515	Dep.; $0.35(BIS)
97(2nd Ed.)	16-12325	Dep.; $1.05(BIS)
247	16-11516	Dep.; $0.21(BIS)
266	16-11517	Dep.; $0.25(BIS)
289	16-11518	Dep.
309	16-11519	Dep.

Report No.	Abstract No.	Availability
310	16-11520	Dep.
PIBMRI–	**(Non-AEC)**	
857-60	16-12616	
932-61	16-12617	OTS
Q-A–		
2392-3-3	16-11818	See TID-14962
R–	**(Misc.)**	
2020	16-11779	See EURAEC-134
60-CDE-01-6*	16-11843	See AD-259169
61SD152*	16-12618	
RADC-TN–	**(Non-AEC)**	
61-130	16-12610	See CAL-AF-1441-A-4
61-138	16-12234	See USCEC-75-3
61-139	16-12621	See USCEC-75-4
RAE-TM–	**(British)**	
MET-PHYS-215	16-12657	
RAI–		
304	16-11688	Dep.(mc); $2.60(fs), $0.95(mf) OTS
RC–	**(Misc.)**	
508	16-12230	See TID-15085
509	16-12032	See TID-15068
RFP–		
234	16-11535	Anal. Chem. 34: 346-8(1962)
RISÖ–	**(Danish)**	
33	16-12658	Dep.(mc)
RM–	**(Misc.)**	
2869-PR*	16-12015	
61TMP-90*	16-12213	See DASA-1269
RME–		
4524(Rev.)	16-11935	Dep.; $0.50(OTS)
RR–	**(Misc.)**	
39*	16-11845	See AD-261503
RTI–		
2513-T6-1	16-11514	See ORO-483
SAH–		
1002	16-11831	Dep.; $2.00(OTS)
SB–	**(Non-AEC)**	
61-56	16-12614	See NP-11414
61-65	16-11686	See NP-11448
SC–	**(Misc.)**	
4672(M)	16-12016	Dep.(mc); $4.60(fs), $1.58(mf) OTS
SCL-T–		
402	16-11587	Dep.(mc); $1.60(fs), $0.80(mf) JCL
403	16-12241	Dep.(mc); $1.10(fs), $0.80(mf) JCL
SCNC–	**(Misc.)**	
336*	16-12030	
SCR–		
307	16-12031	Dep.; $0.75(OTS)
308	16-11928	Dep.; $0.75(OTS)
466	16-12439	Dep.(mc); $1.10(fs), $0.80(mf) OTS
SCTM–		
377-61(54)	16-12016	See SC-4672(M)
SIT-P–	**(Misc.)**	
56	16-12619	see TID-14953
SL–	**(Misc.)**	
1915-2	16-12749	Dep.(mc); $6.60(fs), $2.15(mf) OTS
SM–	**(Misc.)**	
23/12*	16-11934	See NP-11580
23/27*	16-11513	See NP-11579
SRB–	**(Non-AEC)**	
62-1	16-12440	OTS
SRO–		
65	16-12750	Dep.(mc); $1.10(fs), $0.80(mf) OTS
STI-PUB–	**(International Atomic Agency)**	
34(Vol. II)	16-11740	
TDR–	**(Non-AEC)**	
594(1203-01) TR-1	16-12327	See AD-259857
TDV–	**(Canadian)**	
3	16-12659	Dep.; $0.50(AECL)
TEI–		
806	16-11936	Dep.(mc); $4.60(fs), $1.67(mf) OTS

Report No.	Abstract No.	Availability
TID–		
13083	16-12751	Dep.(mc); $3.60(fs), $1.22(mf) OTS
13439	16-12000	Dep.; $3.50(OTS)
14134	16-11866	Dep.(mc); $8.10(fs), $2.90(mf) OTS
14385	16-12586	Dep.(mc); $10.50(fs); $4.13(mf) OTS
14557	16-12752	Dep.(mc); $7.60(fs), $2.45(mf) OTS
14666	16-12227	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14725	16-11355	Dep.; $2.75(OTS)
14770	16-12110	Dep.(mc); $2.60(fs), $1.01(mf) OTS
14775	16-11458	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14779	16-12111	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14953	16-12619	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14957	16-12441	Dep.(mc); $5.60(fs), $1.88(mf) OTS
14962	16-11818	Dep.(mc); $3.60(fs), $1.37(mf) OTS
14970	16-11459	Dep.(mc); $2.60(fs), $0.98(mf) OTS
14979	16-12660	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14980	16-12753	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14994	16-11388	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15010	16-12228	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15020	16-11689	Dep.(mc); $6.60(fs), $2.21(mf) OTS
15041	16-12181	Dep.(mc); $5.60(fs), $1.82(mf) OTS
15042	16-11460	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15044	16-11399	Dep.(mc); $3.60(fs), $1.13(mf) OTS
15045	16-11400	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15046	16-11521	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15047	16-11461	Dep.(mc); $2.60(fs), $0.86(mf) OTS
15058	16-12754	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15059	16-12229	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15060	16-11462	Dep.(mc); $2.60(fs), $0.98(mf) OTS
15065	16-11700	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15066	16-12620	Dep.(mc); $2.60(fs), $0.89(mf) OTS
15068	16-12032	Dep.(mc); $3.60(fs), $1.13(mf) OTS
15073	16-12755	Dep.(mc); $2.60(fs), $0.92(mf) OTS
15074	16-12112	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15075	16-11579	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15078	16-12442	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15079	16-11701	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15080	16-11580	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15081	16-11581	Dep.(mc); $3.60(fs), $1.13(mf) OTS
15082	16-11522	Dep.(mc); $4.60(fs), $1.70(mf) OTS
15083	16-11702	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15084	16-11463	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15085	16-12230	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15106	16-11523	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15116	16-11937	Dep.(mc); $4.60(fs), $1.58(mf) OTS
15117	16-11977	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15118	16-11464	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15119	16-12443	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15121	16-11978	Dep.(mc); $3.60(fs), $1.16(mf) OTS
15122	16-12182	Dep.(mc); $5.60(fs), $2.00(mf) OTS
15123	16-11703	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15124	16-12444	Dep.(mc); $4.60(fs), $1.55(mf) OTS
15126	16-12445	Dep.(mc); $4.60(fs), $1.52(mf) OTS
15127	16-12446	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15128	16-11867	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15129	16-12447	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15130	16-12448	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15135	16-12231	Dep.(mc); $2.60(fs), $1.10(mf) OTS
15137	16-12033	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15141	16-11389	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15142	16-11390	$3.60(fs), $1.22(mf) OTS
15147	16-12449	Dep.(mc); $10.10(fs), $3.92(mf) OTS
15148	16-11704	Dep.(mc); $7.60(fs), $2.45(mf) OTS
15155	16-11401	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15160	16-12113	Dep.(mc); $2.60(fs), $1.01(mf) OTS
15161	16-12450	Dep.(mc); $8.60(fs), $3.14(mf) OTS
15161(Pt.I)	16-12450	Phys. Rev., 125: 1323-8(1962)
15191	16-11705	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15195	16-12114	Dep.(mc); $2.60(fs), $1.10(mf) OTS
15196	16-12232	Dep.(mc); $12.00(fs), $5.18(mf) OTS
15203	16-12017	Dep.(mc); $4.60(fs), $1.46(mf) OTS

Report No.	Abstract No.	Availability
15204	16-11706	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15206	16-12034	Dep.(mc); $5.60(fs), $1.94(mf) OTS
15207	16-12790	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15217	16-12233	Dep.(mc); $2.60(fs), $0.89(mf) OTS
TIM-	**(Misc.)**	
204*	16-12404	See NP-11332
UCLA-		
502	16-11391	Dep.(mc); $2.60(fs), $1.07(mf) OTS
UCRL-		
6498	16-12249	J. Appl Phys. 33: 747-8(1962)
6639	16-11524	Dep.; $1.00(OTS)
9397	16-11743	p.27-35 of "Chemical Effects of Nuclear Transformations. Vol. II." Vienna, International Atomic Energy Agency, 1961.
9711	16-11979	Dep.; $2.00(OTS)
9795	16-11719	J. Chem. Phys. 36: 669-74(1962)
9845	16-12183	Dep.; $0.50(OTS)
9981	16-12587	Dep.; $0.50(OTS)
13032	16-11938	Dep.(mc); $8.10(fs), $2.75(mf) OTS
UCRL-Pub-		
34	16-11355	See TID-14725
UCRL-Trans-		
768(L)	16-11368	Dep.(mc); $1.60(fs), $0.80(mf) JCL
779	16-11392	Dep.(mc); $1.60(fs), $0.80(mf) JCL
783	16-11588	Dep.(mc); $3.60(fs), $1.19(mf) JCL or OTS
UNC-		
3001	16-12661	Dep.(mc); $3.60(fs), $1.22(mf) OTS
UR-		
606	16-11532	Dep.; $1.60(fs), $0.80(mf) OTS
607	16-11533	Dep.; $1.10(fs), $0.80(mf) OTS
USCEC-	**(Non-AEC)**	
75-3	16-12234	OTS
75-4	16-12621	OTS
USNRDL-TR-	**(Non-AEC)**	
532(Rev.)	16-11465	
544	16-11868	
547	16-11707	
550	16-11466	
VDIT-	**(Swedish)**	
16(Ind.61)	16-12184	Dep.(mc)
WADD-TR-	**(Non-AEC)**	
60-22(Pt.III)	16-12235	$6.00(OTS)
60-190	16-11929	OTS
60-370	16-12236	OTS
60-438	16-12115	OTS
60-864	16-12116	OTS
WAL-TR-	**(Non-AEC)**	
142/67	16-11930	$0.50(OTS)
WAPD-BT-		
24	16-12662	Dep.; $2.25(OTS)
WAPD-T-		
1255(Rev.)	16-12680	Nuclear Sci. and Eng. 12: 301-8(1962)
1356	16-12018	Dep.(mc); $2.60(fs), $0.83(mf) OTS
1386	16-12756	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WCAP-	**(Misc.)**	
1900	16-12757	Dep.(mc); $5.60(fs), $1.91(mf) OTS
1933*	16-12669	Dep.(mc); $4.60(fs), $1.49(mf) OTS
4061	16-12758	Dep.(mc); $2.60(fs), $0.83(mf) OTS
WCLT-TM-	**(Non-AEC)**	
59-115	16-11869	
WT-	**(Misc.)**	
1*	16-11356	Dep.(mc); $11.00(fs), $4.52(mf) OTS
18*	16-11357	Dep.(mc); $12.50(fs), $5.33(mf) OTS
29*	16-11358	Dep.(mc); $22.25(fs), $9.90(mf) OTS
59*	16-11359	Dep.(mc); $9.10(fs), $3.26(mf) OTS
60(Ref.)(Pt.IV)*	16-11360	Dep.(mc); $9.60(fs), $3.65(mf) OTS
71*	16-11361	Dep.(mc); $8.10(fs), $2.90(mf) OTS
75(REF)*	16-11362	Dep.(mc); $8.10(fs), $2.66(mf) OTS
767*	16-11363	Dep.(mc); $5.60(fs), $1.76(mf) OTS
770*	16-11980	Dep.(mc); $5.60(fs), $1.97(mf) OTS
773*	16-11364	Dep.(mc); $7.60(fs), $2.51(mf) OTS
777*	16-11365	Dep.(mc); $4.60(fs), $1.64(mf) OTS
779*	16-11366	Dep.(mc); $10.50(fs), $4.25(mf) OTS
1139*	16-12185	Dep.(mc); $1.60(fs), $0.80(mf) OTS
YAEC-		
184	16-12759	Dep.; $2.50(OTS)
ZPh-	**(Non-AEC)**	
106(Agp.6)	16-12622	OTS